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RURAL LAND USE STUDIES IN SOUTHERN AFRICA: AN EVALUATION OF AIMS AND ACHIEVEMENTS

BY

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled Rural Land Use Studies in Southern Africa: An Evaluation of Aims and Achievements, submitted by Mignon Briggs, in partial fulfilment of the requirements for the degree of Master of Arts.

ABSTRACT

The principle of wise land use has been given world-wide recognition during the past half-century. In order to conserve and develop man's greatest resource, the land, its properties, potential and limitations must be fully understood. Given such knowledge, planning is able to work towards the goal of optimum land use. Although the need for study of the land has been acknowledged in Southern Africa since the 1930's, a comprehensive programme of investigation into land resources, present use and land potential has not yet appeared. A number of rural land classifications of varying scope and differing aims have appeared instead.

The objective of this study is to assist in the achievement of improved, and ultimately, optimum land use in Southern Africa by:

(i) assessing the state of land classification and planning in the subcontinent;

(ii) evaluating the area's special needs and problems in the field of land use analysis and planning;

(iii) considering how these needs may best be met in terms of rural land classification.

The study is placed in its areal framework by defining Southern Africa as a region of convenience, comprising the

Republic of South Africa, Rhodesia, Zambia, Botswana, Lesotho and Swaziland. The salient features of the area's physical and social environments are given. Next, the methodological framework of rural land classification in general, and of this study in particular, is discussed. General theoretical problems of land use study and certain problems peculiar to the area are outlined. The crux of the discussion is the evaluation of rural land classification attempts already made in the sub-continent, in terms of what they set out to achieve against what they actually did achieve. Selected studies concerning areas outside Southern Africa are referred to for purposes of comparison. The conclusions reached are of two kinds: the first concerns the feasibility of rural land classifications and planning programmes in this area, while the second outlines the course such resource assessments and plans might follow.

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CHAPTER I

THE AREAL FRAMEWORK

"Southern Africa" is a term which may be given a number of meanings, from Africa south of the Sahara, to Africa south of the equator, and even to Wellington's painstaking delimitation of it as the area south of the 'South Equatorial Divide'."[1] It is essential to define the term as used in this context, though it must be noted that no attempt is being made to delimit a region in terms of any given criteria. This study's dependence on available material, which is not plentiful, means that the areal limits drawn are of necessity those of convenience. These boundaries will follow existing territorial boundaries in order to include nation-wide studies. Southern Africa will therefore be taken to include the territory of the Republic of South Africa, including the disputed territory of South West Africa, the former High Commission Territories of Lesotho (Basutoland), Botswana (Bechuanaland) and Swaziland, the territory of Rhodesia (formerly Southern

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[1] J. H. Wellington, Southern Africa, Vol. I, Cambridge, 1955, p. 3.

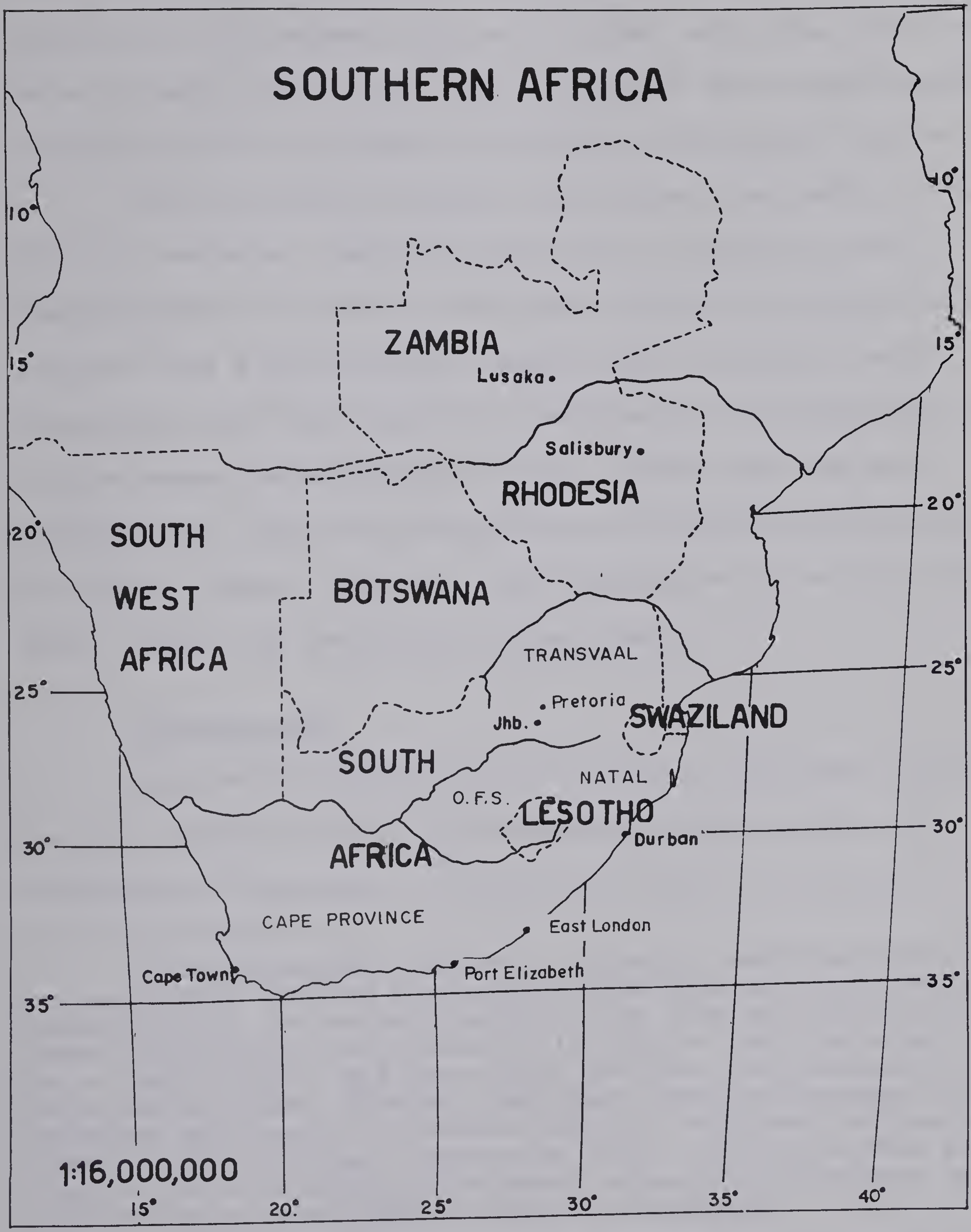
SOUTHERN AFRICA
ZAMBIA
Lusaka
Salisbury
RHODESIA
SOUTH
WEST
AFRICA
BOTSWANA
TRANSVAAL
Pretoria
Jhb.
SWAZILAND
SOUTH
NATAL
O.F.S.
LESOTHO
AFRICA
Durban
CAPE PROVINCE
East London
Cape Town
Port Elizabeth
1:16,000,000
10°
15°
20°
25°
30°
35°
40°

Fig. 1.

Rhodesia) and that of Zambia (formerly Northern Rhodesia).[2] Some unity does exist within this area in terms of the cultural situation as it affects the use of land, since the traditional ways of Bantu society are here juxtaposed with technological practices which are common to settlers of European descent.

This area thus occupies the southern extremity of the African landmass, comprising the bloc of territory from approximately 8° south to 35° south, which is slightly more than one and a half million square miles in extent, with twenty-two and a half million inhabitants.[3] The Atlantic and Indian oceans bound Southern Africa on the west and east respectively, while the neighbouring territories of Angola, the Congo, Malawi, Tanzania, and Moçambique are on the north-west, north, and north-east, respectively.

Physiography

Most of the defined area is part of the great African plateau, which is formed of PreCambrian rock overlain by sedimentary formations. The plateau ranges in altitude

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[2]The Portuguese provinces of Angola and Moçambique have received only sketchy attention in the international journals of geography. No suitable material on land classification in these territories was available in English, Afrikaans or French. As a result Angola and Mocambique have not been discussed in this dissertation, although they have certain features, notably European settlement, in common with the remainder of Southern Africa. This European settlement does, however, differ from that in other regions in any case, since only here have European peasants been encouraged to take up residence.

[3]Latest census figures, as quoted in L. P. Green and T. J. D. Fair, Development in Africa, 1962, give the territorial extent of this area as 1,616,636 square miles, and the population as 22,416,431.

from approximately 3,000 feet to over 11,000 feet,[4] with the plateau edge forming the highest ground and acting as a water-shed between the headwaters of plateau and coastal drainage systems.[5] The composition of the plateau edge, and the climatic processes affecting it, have produced a feature which varies "in structure, in height, in abruptness and steepness of slope and in many other ways."[6] The Great Escarpment which ranges from extremely prominent to barely discernible, greatly affects rainfall distribution and communications in Southern Africa. "Whether it be from the physical or economic aspect it is the most fundamentally important physical feature in the subcontinent."[7] Below the plateau edge is a belt of varied topography, mainly eroded slopes, but also including folded topography in the south, and a broad eastern coastal plain.

The coastline of Southern Africa is relatively short due to the absence of indentations, and good natural harbours are rare, although Cape Town and Durban are exceptions. Harbours located on navigable rivers are almost entirely absent, except for East London, where the Buffalo river is navigable for a short distance from its mouth. The heavy silt load

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[4]Thabana Ntlenyana, on the Basutoland massif, is 11,425 feet.

[5]Wellington, _op. cit_., p. 38.

[6]_Ibid_., pp. 38-9.

[7]_Ibid_., p. 39.

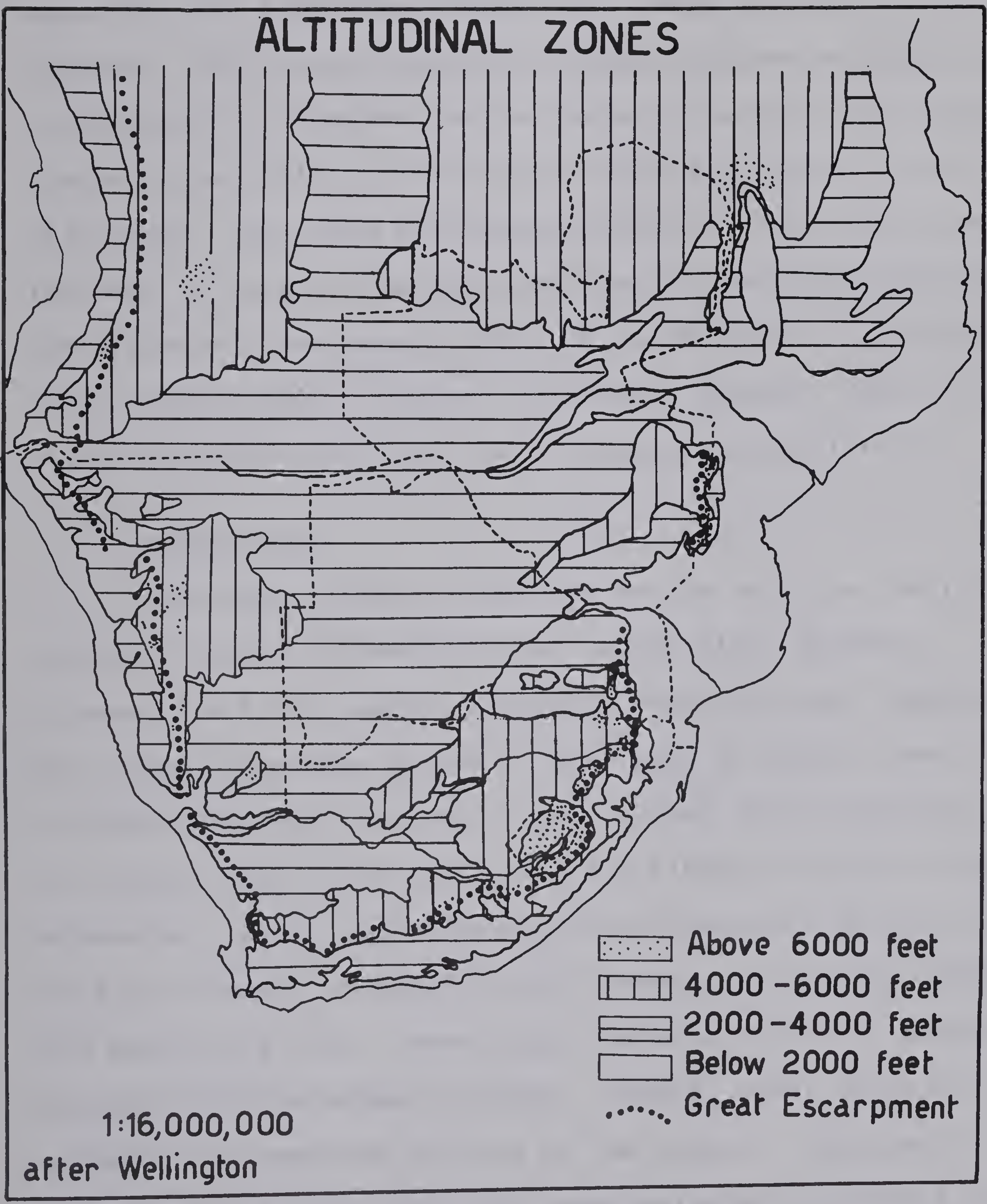
ALTITUDINAL ZONES
Above 6000 feet
4000 - 6000 feet
2000 - 4000 feet
Below 2000 feet
Great Escarpment
1:16,000,000
after Wellington

Fig. 2.

carried by rivers, with the rapid formation of such depositional features as sand-bars in lagoons, make coastal dredging necessary and expensive. Generally, there are few usable harbours, while those Southern African territories which with are landlocked are dependent on the ports of neighbouring territories, especially on those ports which are located on the east coast. The warm Moçambique current of the Indian Ocean has much to do with the more inviting character of this coast, since the cold Benguela current of the Atlantic is associated with a great deal of fog and unpleasant weather, while little usable precipitation falls on the western coastal region.

Hydrography

The hydrography of Southern Africa reflects the physiographic division between plateau and marginal systems. Virtually all the plateau rivers do reach the sea, however. The largest drainage system in this part of Africa, and virtually the only navigable one, is that of the Zambezi, while the Orange-Vaal river system and the Limpopo system are less extensive. Along the eastern and south-eastern margins of this area are coastal streams of short length, with steep gradients and heavy silt load. Generally, Southern Africa is poorly supplied with perennial streams. Indeed, water supply is probably the greatest problem of the region. The position was described by a 1952 government commission of the (then) Union of South Africa:

> The whole mean annual runoff from precipitation throughout the Union is considered by the

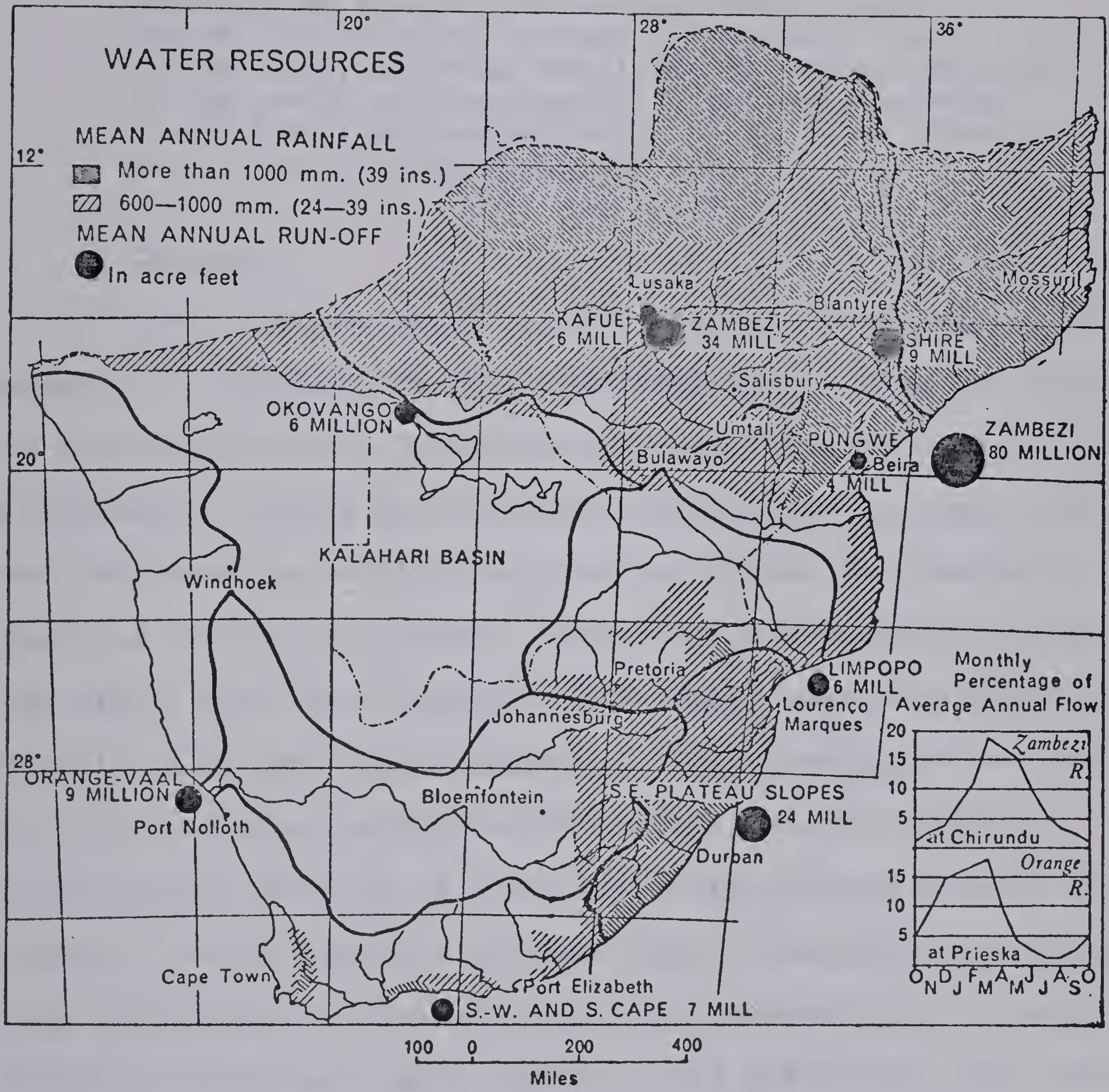

Fig. 3.

From L. P. Green and T. J. D. Fair, Development in Africa, Witwatersrand University Press, 1962, p. 64.

Department of Irrigation to be in the neighbourhood of 20 million morgen* feet per annum. When it is realised that the surface area of the Union is 133 million morgen, the meagreness of the total water supply becomes apparent. Of the total runoff rather more than half cannot be used, either because the runoff is too near to the coast, or because there are no storage sites on some of the rivers, or because really large floods in the rivers cannot be stored at all. The quantity of water available to supply the whole of the needs of the country is probably between 6 and 7 million morgen feet. Of this the greater part flows unhindered to the sea.[8]

Climate

Precipitation is of course vital to water supply, and hence it is perhaps the most important single climatic factor in the sub-continent. The Inter-Tropical Convergence Zone is responsible largely for rainfall distribution in Zambia and most of Rhodesia, while other factors affect the southerly parts of the sub-continent. Generally, the eastern half of the area is the best watered, since humid oceanic air-masses deposit rains over the escarpment. Here, average annual rainfall is sometimes as high as 80 inches. Further inland, convectional rainfall is common over the plateau surface in summer. In the north of the area under discussion, precipitation is generally associated with the movement of the intertropical convergence zone, which causes a distinct 'wet season'. Winter rainfall occurs at the south-western tip of Southern

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[8]Appendix to Thorrington-Smith, Towards a Plan for the Tugela Basin, Pietermaritzburg, 1960. Report of the Commission of Enquiry Concerning the Water Laws of the Union, U. G. No. 11, 1952, Par. 36. (*1 morgen is equal to 2 1/9 acres.)

Africa, where Mediterranean climatic conditions prevail. Immediately east of this is an all-season rainfall zone which has characteristics of both the summer and winter rainfall zones which it adjoins. Most of the Republic of South Africa experiences summer rainfall, when potentially unstable air rises up the slopes of the escarpment and convectional rain falls.

Rainfall generally decreases from east to west, except in the south-west, with the 15-inch isohyet bisecting most of the area longitudinally. This isohyet is reflected in population density, which falls off markedly to the west of the line, as well as in the way the land is used. Due to higher evaporation rates, strong insolation, and heavy run-off from slopes, rainfall effectiveness is frequently low, while a large part of Southern Africa in any case receives less than 25 inches per annum, which is "the amount generally considered to be the minimum required for successful crop farming over the summer rainfall part . . . ."[9] Severe droughts are frequent in this part of Africa and there has to be some correlation between amount of precipitation received and reliability, with areas of heavy precipitation having higher reliability than those of lesser precipitation.[10] Marginal areas of crop production, such as those with 15-20 inches of rainfall per annum, suffer from frequent damaging droughts.

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[9] Wellington, op. cit., p. 239.

[10] Loc. cit., p. 255.

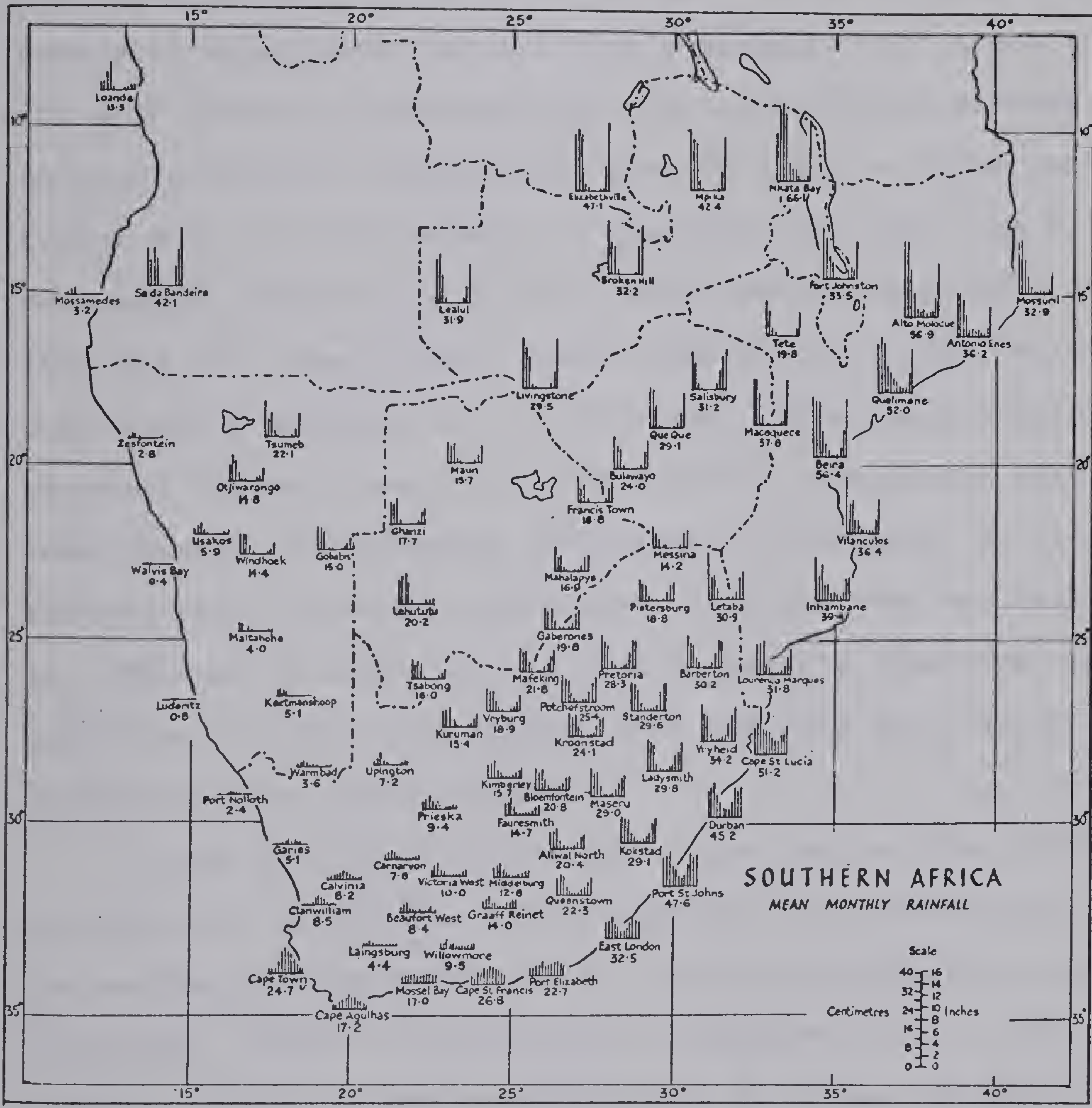

Fig. 4.

From: J. H. Wellington, Southern Africa, Vol. I, Cambridge University Press, 1955, p. 241.

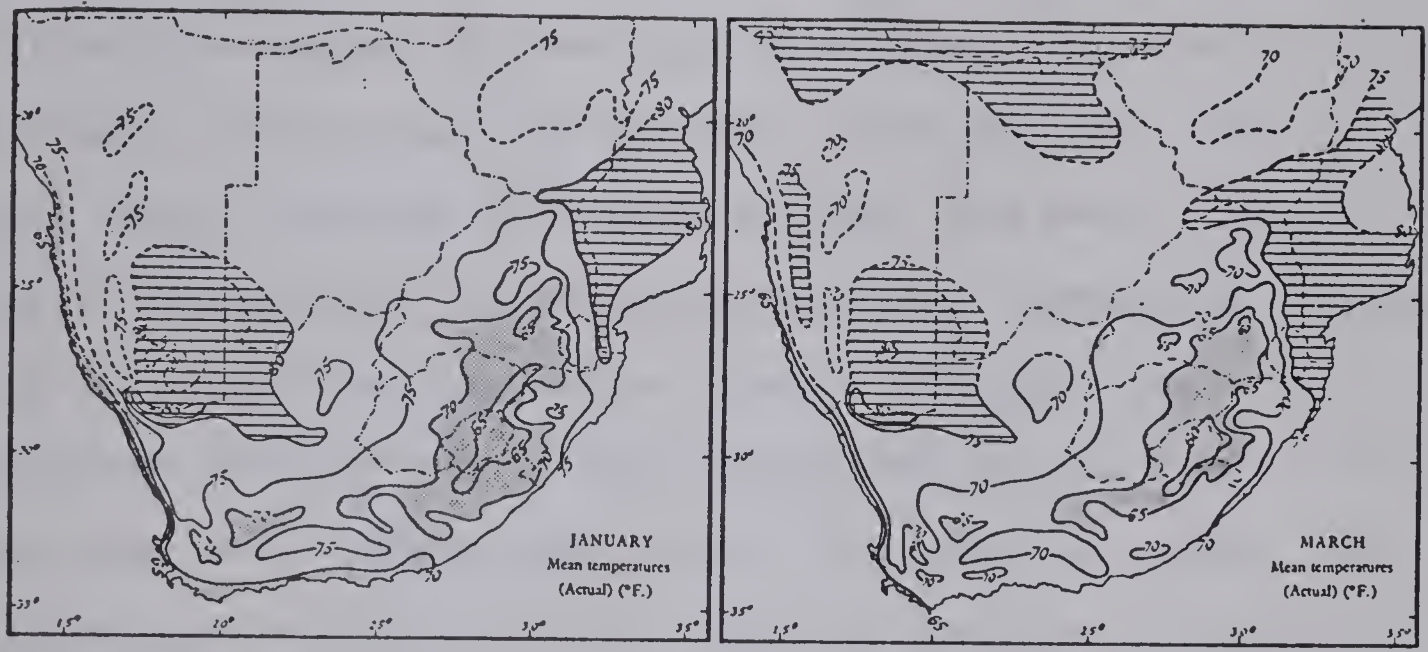

Fig. 5a. Mean actual temperatures, January and March
(*after S.A. Meteorological Office*).

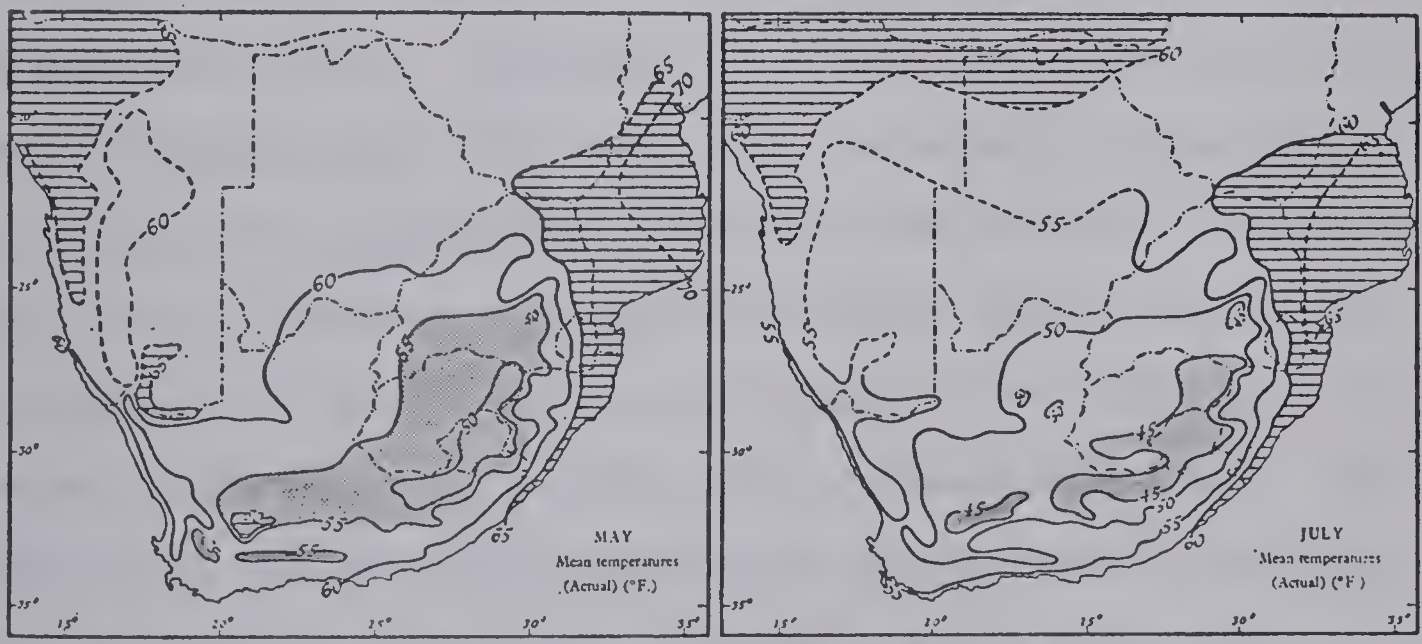

Fig. 5b. Mean actual temperatures, May and July
(*after S.A. Meteorological Office*).

From: J. H. Wellington, Southern Africa, Vol. I, Cambridge University Press, 1955, p. 221.

Soils

In recent years, soil survey has attracted a good deal of attention in Southern Africa, and as a result many pedological studies have been undertaken. Because of the perennial difficulties caused by shortage of trained personnel, shortage of funds, and the size of the area, much detailed work remains to be done, although an excellent start has been made with general surveys for the entire area under discussion, and some work in detail for particular areas. Probably the single most important factor to have been recognized is the close relationship many soils (even deep soils) have with the parent rock.[11] Lithological soils are often immature, but the combination of steep slopes and high intensity rainfall may also exert some influence on the widespread occurrence of these soil types in Southern Africa. However, C. R. van der Merwe has classified South African soils into soil zones related to rainfall zones.[12] He recognizes, inter alia, laterites and lateritic soils, black clay soils, podsols, lithological soils, sandy soils, and combination of sands, clays, and loams. The close relationship between soil type and parent rock is frequently noted, and the difficulty of separating geological and climatic processes in soil formation is stressed. Zambia's soils have been surveyed

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[11]Wellington, op. cit., p. 305.

[12]C. R. van der Merwe, Soil Groups and Sub-Groups of South Africa, Pretoria, 1941.

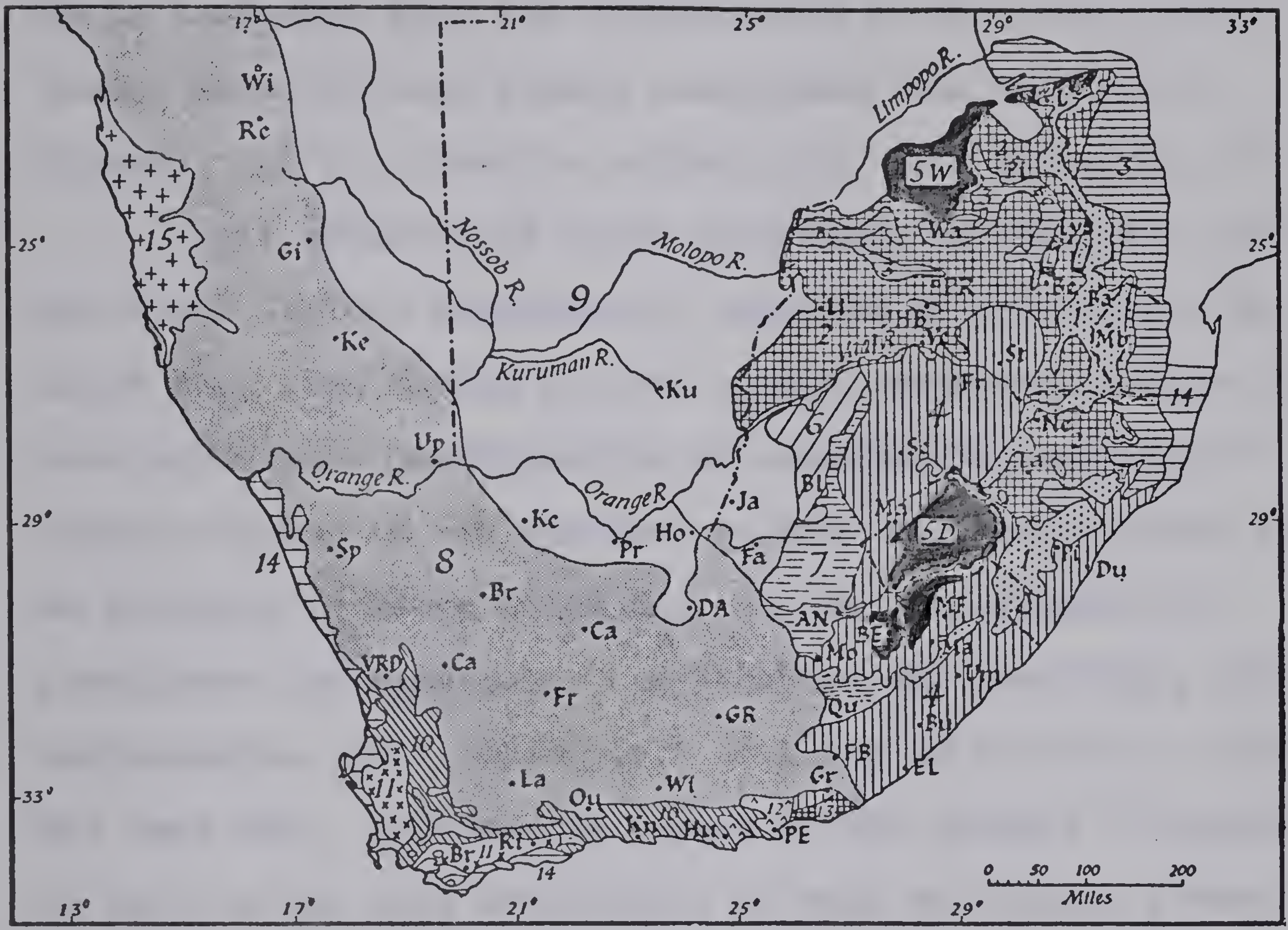

Fig. 6. Soil groups of South Africa (*after C. R. van der Merwe*).

(A) Summer rainfall area

1 Laterite and lateritic soils

2 Ferruginous lateritic soils

3 Black clay soils / Eastern lowveld soils } Unleached sub-tropical soils

4 Gley-like podsolic soils

5 Waterberg (W) / Lydenburg (L) / Drakensberg (D) } Lithological types

6 Sandy soils

7 Solonetzic soils

8 Desert soils

9 Kalahari soils

(B) Winter rainfall area

10 Grey sandy soils of Table Mountain Sandstone

11 Gravelly sandy clay loam on clay

12 Sandy loam on lime and clays

13 Reddish brown sandy loam on lime and sandy loams (deep)

14 Coastal aeolian sand on lime and sandy soils

15 Shifting sand

From: J. H. Wellington, Southern Africa, Vol. I, Cambridge University Press, 1955, p. 307.

in a manner which correlates with van der Merwe's work,[13] while Rhodesian work has concentrated on the lithological basis, with two main groups recognized, one related to igneous, and the other to sedimentary, rock formations.[14]

Soil water is of great importance in using the soil, and South African experiments, reported by Wellington, have shown that even during the wet season, evaporation from the soil may exceed precipitation by considerable amounts.[15] Organic matter is not abundant in most Southern African soils, so nitrogen is often deficient, as are the elements of phosphorus and manganese. In locating and rectifying such deficiencies, good pedological work may be the key to successful land use. Impermeable layers in the subsoil ("hardpan"), as well as the high erodibility of soil on slopes, present other dangers to the farmer. Soil erosion is generally regarded as Botswana's greatest problem, but much of Southern Africa is similarly afflicted, with vast quantities of invaluable topsoil being washed away every year as useless silt in the rivers, leaving once-fertile land denuded. In this regard, slope is of great importance, since heavy erosion occurs on sloping land.

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[13]Trapnell, et. al., Vegetation-Soil Map of Northern Rhodesia, Lusaka, 1948.

[14]B. S. Ellis, The Soils of Rhodesia, Salisbury, 1951.

[15]Wellington, op. cit., p. 332.

Vegetation

To the worker in land use, natural vegetation is one of the most important factors in the geographical background of this area, partly because Southern Africa has not long been settled. In such an area, some authorities consider ecological indicators to be much more valuable than present use in determining land use capabilities.[16] Natural pastures still support most of Southern Africa's pastoral industries, while vegetal cover greatly affects both soil formation, and soil loss or erosion. The brief description of vegetation given here follows Wellington [17] in recognizing five main vegetational types. The first to be considered is the sclerophyllous bush of the south-western Cape, which is a typical 'Mediterranean' form of evergreen shrub, with little or no grass or indigenous tree growth. As pasture, the sclerophyll is utilized only by goats, but grass pastures can be introduced into this region; exotic trees, such as pines, wattles and eucalypts, have also been established here with considerable success. Semi-desert and desert types of vegetation occur between the sclerophyll and the interior grassland, covering a wide range of plants which are of little economic importance. East of the 15 inch isohyet, in the summer rainfall zone of South Africa, grassland occurs in almost pure form, with little

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[16] E.g., J. A. Pentz, An Agro-Ecological Survey of Natal, Department of Agriculture Bulletin No. 250, Pretoria, 1945.

[17] Wellington, op. cit., Chapter 10.

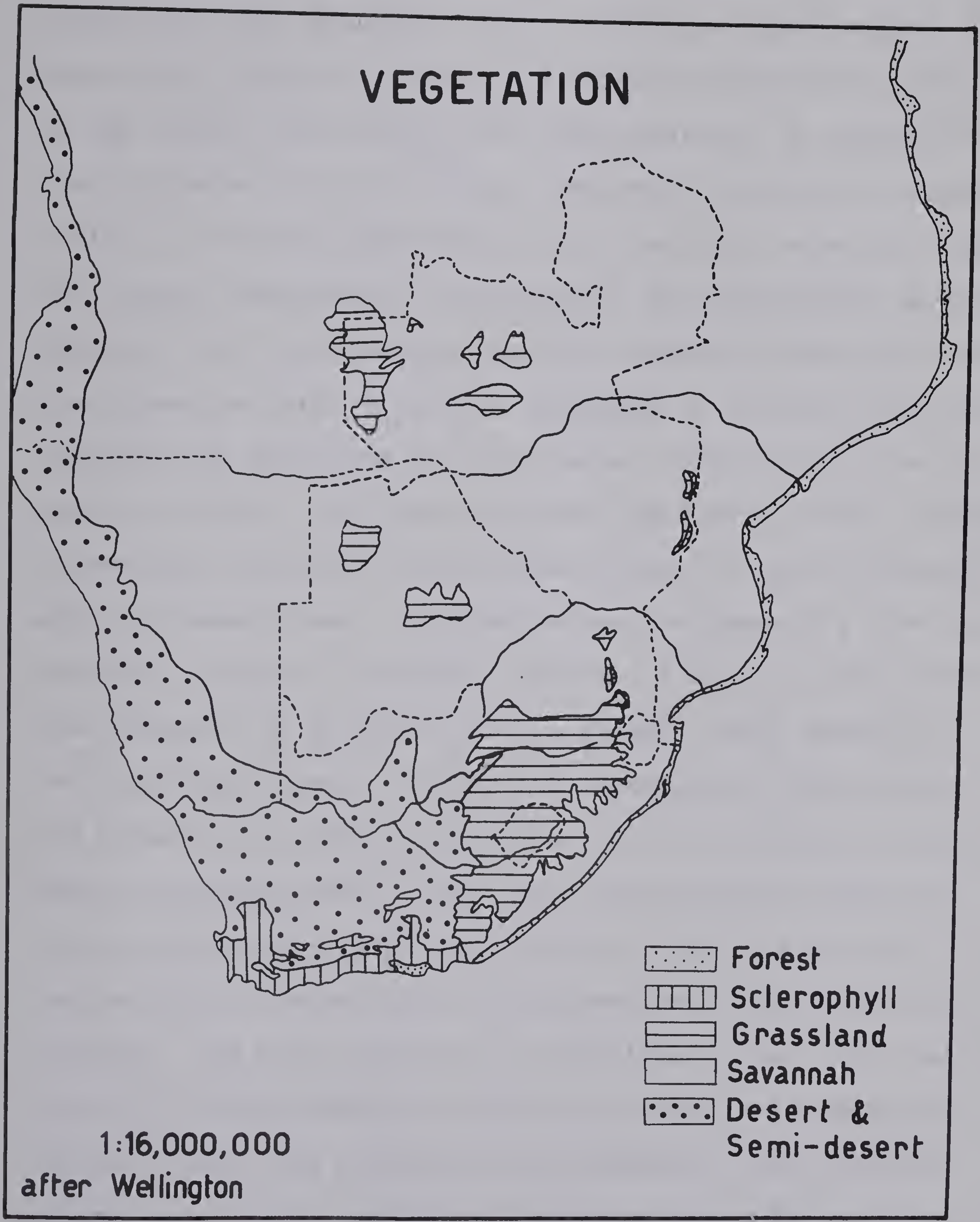
VEGETATION
Forest
Sclerophyll
Grassland
Savannah
Desert &
Semi-desert
1:16,000,000
after Wellington

Fig. 7.

indigenous tree growth, though small areas of temperate forest have been destroyed to make way for agriculture. Both "sweetveld" and "sourveld" occur in the grassland region, the distinction being that sweetveld remains palatable to stock in the winter, even while dry, while sourveld is unpalatable once it becomes dry in winter. The pure grassland of Southern Africa is of great importance to the pastoral industry, while its correct management, conservation, and improvement have been subjects for a good deal of valuable research and experimentation concerned with land use. Savannah or bushveld generally replaces the grassland in warmer areas, especially those of lower altitude. The tree and grass types vary, while all types of savannah are found, from closed forest to open grassland with scattered trees. Savannah areas are generally used for pastoral purposes in Southern Africa. The last broad vegetation category to be noted here is forest, which covers an estimated one-quarter of 1% of the Republic of South Africa and probably as little proportionally of the other territories under discussion here. "The basal environmental condition for the occurrence of natural forest in the subcontinent is the perennial availability of adequate soil and atmospheric moisture, and this condition is fulfilled in but few localities."[18] Prior to the settlement of the area by Bantu and Europeans, natural forest was probably more widespread, but its slow growth rate has not aided reforestation since the original

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[18] Wellington, op. cit., p 301.

stands were destroyed. Temperate, subtropical, and montane forests, all of very different types, make up the natural forests of the area.

Population and Settlement

The population of any area can be considered one of its greatest resources, and the diverse population of Southern Africa is at once the source of many of the subcontinent's greatest difficulties, and the hope for its future. According to the latest available statistics, approximately twenty-two million inhabitants are found in this part of Africa, seventeen million being native Africans, rather more than three million being people of European descent, two million being Asians, and the remainder people of mixed race, who are known as Coloureds in South Africa.[19] Although different terminology is used in different territories, the indigenous African people will generally be referred to as Bantu here, since it is their peculiar type of language, (which always uses some form of the root 'ntu' for human being)[20] which distinguishes them from the true negroid peoples of Africa. Generally the Africans in this region belong to groups considered to be Southern Bantu, who possess some cultural homogeneity, common

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[19] Green and Fair, op. cit., p. 75. It should be noted that African census reports are not entirely reliable, principally due to enumeration difficulties, so estimates are sometimes used. The Republic of South Africa and South West Africa have figures available for 1960. All other figures are for 1956, except for Botswana, where 1946 figures had to be used.

[20] C. G. Seligman, Races of Africa, London, 1957.

linguistic characteristics, and a measure of somatic similarity, though Hamite admixture in the past has given rise to a variety of somatic types. The Europeans or Whites are not colonial administrators, but permanent settlers whose forefathers emigrated from Western Europe; immigration to Southern Africa has not been substantial during the past fifty years. The Asians are generally people of Indian origin who were first employed along the east coast where they later chose to remain. The Coloureds are, of course, the result of miscegenation.

Although prehistoric man definitely lived in Southern Africa, the first notable waves of settlement came to an area thinly populated by Khoisan people, the Bushmen and the Hottentots, who were nomadic hunters. Towards the end of the eighteenth century Bantu pastoral tribes migrating southwards from East Africa met the vanguard of European settlers moving north, in what is now the Eastern Cape Province, along the line of the Great Fish River. European settlement in Southern Africa predates this, but was previously confined to small coastal outposts; most of the waves of migration, or treks, to the interior, occurred during the nineteenth century. Two groups, Bantu and European, seeking ample land for their pastoral pursuits frequently came into conflict, which resulted in the tangled pattern of settlement which has been perpetuated. Discovery of mineral wealth in Southern Africa at the end of the nineteenth century set off processes of urbanization which

have further complicated the settlement pattern. Nevertheless, the bulk of the area's inhabitants reside in the better-watered eastern part. The major urban centres of the subcontinent are very evident on a population distribution map, but other heavy concentrations of population which show up are essentially rural: ". . . these African concentrations are the result of the stabilization of formerly fluid tribal movements by European administrators: the freezing in their tracks of peoples until then normally on the move."[21] These concentrations are found mostly in the areas reserved for Bantu: Native Reserves, in the Republic of South Africa and Rhodesia, and the territories of Lesotho and Swaziland. Most such areas are economically stagnant,[22] because too many people are dependent on subsistence farming, often in areas having poor natural resources.

In each of the several territories discussed, land ownership laws are different, but most of them do set aside areas for occupance by native Africans, or Bantu, alone. The Tomlinson Report[23] found that in 1954 12.9% of the (then) Union was Bantu area. J. H. Wellington estimates some 25% of South West Africa is classified as "Home Areas" at the present

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[21]Green and Fair, op. cit., p. 76.

[22]Loc. cit.

[23]Commission for the Socio-Economic Development of Bantu Areas Within the Union of South Africa, Pretoria, 1954.

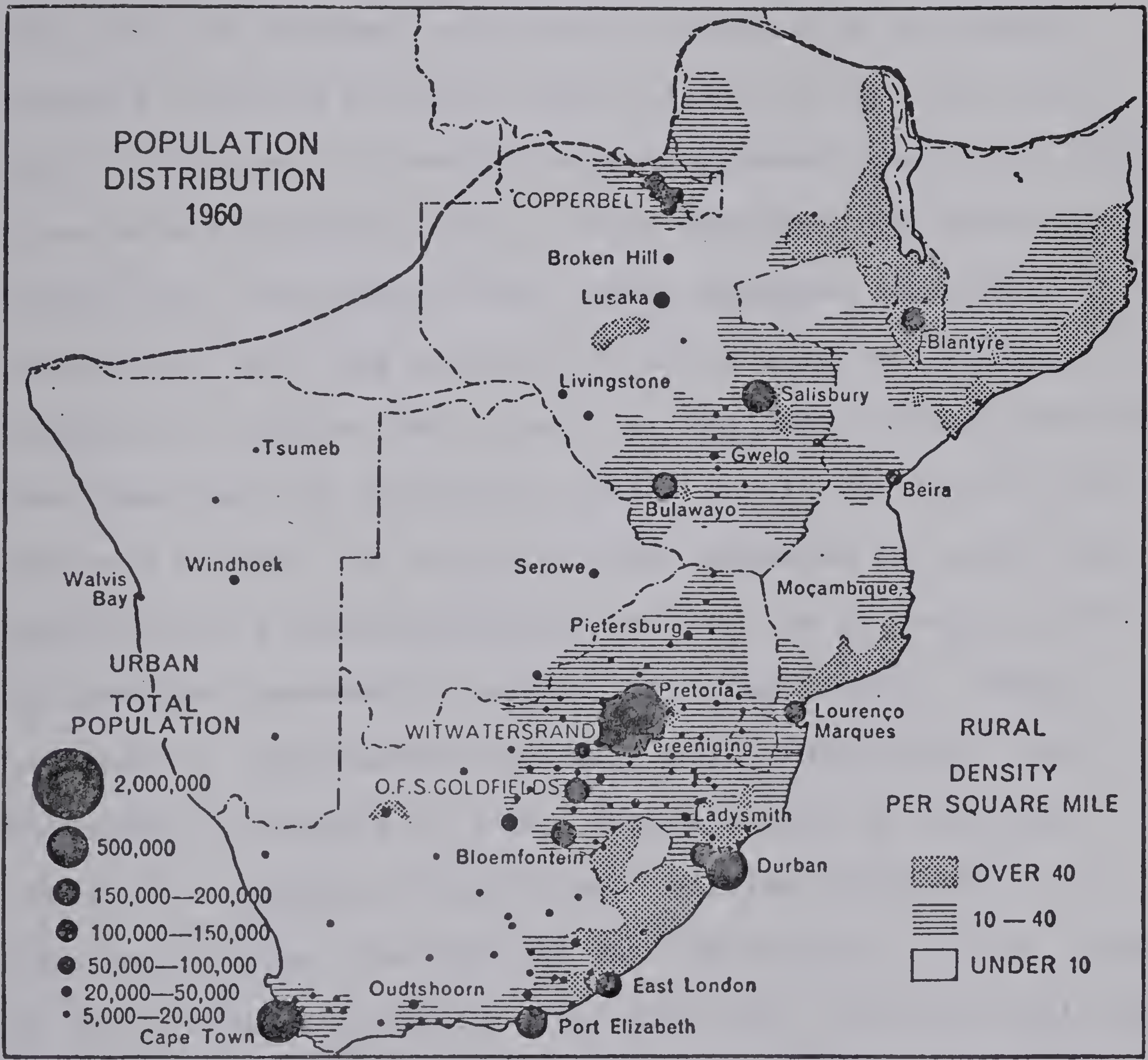

Fig. 8.

From: L. P. Green and T. J. D. Fair, Development in Africa, Witwatersrand University Press, 1962, p. 74.

time.[24] Government policy aims at consolidation and expansion of such areas. In fact, the actual areal extent changes constantly. In Lesotho, all land is held tribally, but in Swaziland about half the territory is privately owned by Europeans. Botswana is mostly under tribal ownership, with some areas of farming concessions occupied by Europeans. Rhodesia's Native Reserves cover 43.21% of the territory's area.[25] Africans do settle outside Reserve areas, but these areas have preserved a way of life considerably closer to the traditional than other areas, where European methods of agriculture have had more influence on African farming. Attempts to improve both stock rearing and arable production have been made by government agents in all the territories of Southern Africa, but they have been hampered by a shortage of funds and of trained personnel, as well as by suspicion of new methods intended to replace the traditional. Major barriers to improvement have been collective rather than individual ownership of land, fragmentation of holdings, attempts to practise traditional shifting cultivation in a restricted space, the lack of farm machinery, and the absence or unwillingness of men to till the soil. In the traditional way of life of the Bantu, the men were principally warriors

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[24]J. H. Wellington, South West Africa: The Facts About the Disputed Territory, Optima, March, 1965.

[25]Federation of Rhodesia and Nyasaland, An Agricultural Survey of Southern Rhodesia, Part I, Agro-Ecological Survey, Table 8, p. 104.

and hunters, leaving the women to till the soil: now that the need for warriors and hunters is past, many Bantu men prefer to sell their labour rather than do "women's work." Arable production, however, has become much more important to these people as restricted areas have limited their pastoral pursuits. With an unlimited supply of land, methods of shifting cultivation were in fact well-adjusted to the Southern African environment, but where there is a finite supply of land, it must produce more heavily and it should be capable of sustained use, whereas the shifting cultivator leaves the soil to regenerate once the soil fertility declines. A complete change of attitude is required, so that land is conserved rather than exploited.

European farmers have peculiar problems of land use too, some of them connected with attempts to transplant European methods of agriculture to African environments. Trial and error have resulted in much hardship, but also in the gain of valuable knowledge. Agricultural research has produced new strains of disease- and drought-resistant crops, improved breeds of stock to withstand extremes of heat, as well as means of combatting endemic disease. Nevertheless, poor agricultural practices are rife, among them: unnecessary veld-burning to encourage the growth of spring grass, unchecked soil erosion and the use of marginal areas to cultivate crops yielding a high cash return. All too often, poor practices are the result of ignorance and the attempt to continue

traditional practices of little benefit to either man or the land. For instance, the presence of abundant labour inhibited farm mechanization until recently.[26] Improved knowledge of the land may be the key to improved farming practice; it certainly has paid handsome dividends when single units have received the benefits of government advisory services and management.[27]

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[26]The 1961 Education Panel First Report, Education for South Africa, Table 3, p. 7, Witwatersrand University Press, Johannesburg, 1963.

[27]K. E. W. Penzhorn, "Farm Planning," South African Geographical Journal, Vol. XLIII, 1961, pp. 49-52.

CHAPTER II

THE REASONS FOR STUDYING LAND CLASSIFICATION IN SOUTHERN AFRICA

Mounting population pressures throughout the world continue to increase the demands upon available land resources. Apart from such minor exceptions as reclamations from the sea, land is finite in area. The answer to the growing demands for more food and more living space lies not in increasing the area of the land, but in making the best possible use of what is available. In order to determine the most advantageous use of any tract, so that land is neither wastefully nor wrongfully used, it is essential to have a full knowledge of the land, its physical resources, its limitations, and the very important human factors which affect its use. Ideally, a decision regarding the use of an area should be based on an accurate and well-organized knowledge of the physical properties, its historical background, its economy and the best possible idea of what the future holds for it.

Land use which is in harmony with natural and prevailing economic conditions is usually beneficial both to the individual and to larger groups. Examples of poor or

ruinous uses can be seen in far too many places, together with the consequent unhappy results for the people dependent on the land. The conservation movement which gave impetus to the study of land use was generated to some degree by 'natural' disasters like the American Dust Bowl crisis, set off by injudicious use of land. Well-conceived objective study of the land can provide a secure framework on which to build a structure of good land use. In the process, problems can be identified and remedies sometimes found, but above all, haphazard methods of trial and error, with the frequently unhappy effects of poor adjustment, can be avoided. The logical sequence must be the acquisition of knowledge, then planning stemming from a consideration of all the factors involved. Planning for the sake of planning, without adequate basic knowledge, is useless.

Every part of the world has problems concerning land use, some of the problems being common to ~~other~~ many areas. Many areas possess combinations of problems which may be unique, while they may also be fortunate in having a particular combination of advantages. Southern Africa has a number of special problems which urgently require definition, understanding, and where possible, solution. There is an undoubted need for a full, well-organized study of Southern Africa's land resources. Its beginnings may of necessity be small, but a clearly defined aim, together with continuity and simplicity of execution, is of paramount importance.

Aggravating more widespread problems of land use study, such as rural-urban competition for land, are problems stemming from the peculiar physical, economic, social, and political circumstances of Southern Africa. On the physical side, for example, the effectiveness of the quantity of precipitation received greatly affects the use and potential of land in the subcontinent. The complex social situation creates many problems where a relatively large non-indigenous group is juxtaposed with a large indigenous population. Though each group may have a distinct way of life, each of necessity affects the other, and they are closely bound together in the economy of the area. Contrasts are sometimes strikingly evident. For example, technologically advanced methods of agriculture exist side by side with primitive traditional methods. Social, historical, and political circumstances have resulted in the division of many areas for occupation by different groups, with large numbers of people sometimes occupying areally restricted tracts. Imposed overpopulation results, with the situation being aggravated by backward agricultural methods, overstocking, a shortage of cultivable land, and a shortage of capital. A migratory labour system also deprives many families of their men for months or even years at a time, thus intensifying the problem of caring adequately for the soil. Other land problems may stem from the customary Bantu attitudes and values respecting cattle, which traditionally have more importance as status and

ritualistic symbols, than they have as food or in trade. Soil erosion is another major land use problem in Southern Africa, and one which has spurred much of the practical and theoretical work done in this area.

1. A Statement of Aims and Objectives

In evaluating the state of land use study in Southern Africa, it is evident that there is a need for the organized collection of relevant data, its analysis, and resulting recommendations regarding the wisest and most advantageous use of the land. Existing studies may have dealt superficially or in considerable depth with their chosen areas, but there has at no time been a detailed land use survey of sub-continental dimensions. Separate studies have not been co-ordinated with each other in any way, whether by the choice of a common objective or similar methods. As a result, the findings of these studies are so dissimilar that they could not be used in a national evaluation of resources. Major difficulties, such as patchy map coverage, face a land use survey of Southern Africa, but the obstacles should not prove to be insurmountable. The goal of more efficient resource use through better understanding is worthy of attainment, particularly because political changes in progress now, demand increased efficiency in using the available land.

The study of land use may be deemed important for a variety of reasons. Many will agree that important aims are

to ensure the maintenance of "renewable resources undiminished or increased for future generations, to provide the most prudent use of non-renewable resources, and to resolve conflict for space and the use of resources".[1] In parts of Southern Africa, the renewable resources of land, water, and vegetation are in danger of grave damage, and sometimes total loss, as topsoil is blown and washed away, underground water is tapped without heed for its replenishment, and palatable, nutritious botanical species are displaced by noxious plants in the wake of over-grazing. It is probably true that non-renewable resources, such as gold, are today more carefully controlled and conserved in Southern Africa than are the renewable, since their finite life is an everpresent warning to those who exploit them. The technically renewable resources may be entirely lost if used in the way Jean Brunhes aptly describes as "robber economy". If the resources which provide man's livelihood are not to be destroyed, it is essential that he assess and understand them, make decisions regarding their most advantageous use in the present and for the foreseeable future, and put these decisions into effect. Conflicts for space and resources should be carefully analyzed before any arbitrary or haphazard solutions are implemented. These conflicts are common in Southern Africa, where ethnically distinct groups compete for living space and for agricultural

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[1] Report on Land Use, Conservation Council of Ontario, 1960, p. 7.

land in the most favoured areas, leaving the less favoured areas sparsely populated.

Pressures on land are increasing in this relatively sparsely populated area,[2] while the environment is much affected by the complex political, social, and economic conditions which prevail. Even less here than in other parts of the world can the land use planner base his decision regarding the best use for a tract of land solely on its physical attributes. He may indeed be attempting to preserve a livelihood for people in areas of almost unbearable population pressure, while in the same country vast tracts support only one or two persons per square mile.

Land classification has been attempted in the Republic of South Africa and Rhodesia (formerly Southern Rhodesia) for a variety of reasons, and both territories have been covered by official agro-economic surveys, and less complete agro-ecological surveys.[3] Government agencies have undertaken

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[2]1956-57 figures for Southern Africa give population density per square mile as 15.5 in contrast with several thousand persons per square mile in the lowlands of south-east Asia. See L. P. Green and T. J. D. Fair, Development in Africa, Johannesburg, 1962, Table 4, p. 53. In this work Southern Africa is defined as including the Republic of South Africa, South West Africa, the former Central African Federation, Mocambique, and the High Commission Territories of Basutoland, Bechuanaland, and Swaziland.

[3]Agro-Economic Survey, Union of South Africa, Division of Economics and Markets, Pretoria, 1947-51; J. A. Pentz, An Agro-Ecological Survey of Natal, Pretoria, 1949; Federation of Rhodesia and Nyasland, An Agricultural Survey of Southern Rhodesia, Salisbury, n.d.

studies which include sections on land use, but the main body of the existing work is made up of the reports of research groups and the theses of individuals. Nowhere in Southern Africa has there ever been a national inventory of land use at all comparable to the celebrated Land Utilisation Survey of Great Britain, nor has one been attempted under the auspices of the World Land Use Survey. Excellent regional planning preceded some major changes in the Republic, (e.g., the Orange Free State Goldfields' development), and declared "soil conservation districts" in the Republic are restricted tracts where attempts are made to correct misuse of land by means of co-operation between government officials and individual farmers. Declared Betterment areas in African areas have achieved much on a limited scale, by allocating available land to the most advantageous use, and keeping it in good condition, or rehabilitating abused areas. Commendable as this type of land planning may be, and it has undoubtedly done much to halt the waste and impairment of usable land, it is time the jigsaw was put together, with the missing pieces inserted to make a complete picture. At present remedial measures are often taken only in isolation and when a situation has been critical. If reliable country-wide surveys of natural conditions and present use were completed, potential trouble spots could be pinpointed before damage to the land becomes serious. Studies of land potential and optimum use should not be overlooked, but it is important first to lay down a

secure foundation of knowledge about the way the area's land resources are being used. If the political process of creating Bantu and White Homelands continues in the Republic of South Africa, it is of the greatest importance that the resources and present use of the land be well-known to the planners. If this is not done, there is the danger that areas neither economically viable, nor capable of supporting even a limited population at subsistence level, may be set up.

A limited amount of land use information is given on government topographical maps, but this does not constitute anything like a complete land classification. Southern Africa does possess some excellent map coverage on several scales, but the sub-continent is not completely covered by up-to-date base maps of one suitably large scale, though there is complete coverage by the one to one million I.C.A.O. maps. Map making has been in the hands of a variety of agencies, from the South African Trigometrical Survey to the Royal Air Force, and their programmes have not aimed at extraterritorial coordination. Aerial photographic coverage is also patchy, with some areas having excellent coverage, successive surveys and high quality photographs; other areas do not have even initial coverage. Distances are considerable, communications not uniformly good, and trained workers are few, so some method of sampling may be the only possible way to achieve a rural land use survey of this area.

Since the obstacles to the completion of such a survey

are considerable, it is essential that it be carefully planned and well executed to avoid wastage of time, money, and skilled manpower. A suitably comprehensive but clear classification is a prerequisite, and one may well be developed in a trial survey or surveys. The desirability of integrating such a survey with the World Land Use Survey programme also needs full consideration.

Briefly, the objective of this dissertation is (i) to evaluate Southern Africa's special needs in the field of land use analysis and planning, (ii) to consider whether these needs may best be met by a single comprehensive classification of rural land use, and (iii) to assess the state of land use work in Southern Africa, with particular reference to the ways in which the special needs of the sub-continent may best be met.

2. Terms and Methods of Analysis to be Used

Confusion in terminology may arise in some fields of geographic study, because terms have been coined or borrowed from related studies or other languages, to meet a need for a specific term of precise meaning. In the study of land classification, as in other fields which have expanded rapidly, terms are often confused or used without precise definition; in some instances, theory appears to lag behind practice. Opinions may also differ as to the exact meaning of a particular term, and different workers may well use different terms to signify the same thing. Definitive writings on the methodology

of rural land classification are few in number, and the inter-disciplinary nature of much work in this field has enriched its terminology without always adding precision to it. Terms used loosely add only confusion and obscurity. An attempt will be made to define certain key-words, as they will be used in this work, with the reservation that not all the authors whose work will be discussed have followed this terminology. Differences will be noted as they occur. At the outset, it should be stressed that this discussion is restricted to a rural context, and so the terminology used should be taken to apply only to such a context.

Since the studies of land use and land utilization are part of the broader field of land classification, the latter will first be defined in Fox's terms: "land classification is a general concept embracing all investigations into the physical and cultural characteristics of the land which have as their aim the study of land for a particular purpose".[4] Land use and land utilization are more restricted in that they deal exclusively with the use of the land. Fox draws a distinction between land use and land utilization which, whatever its contribution to geographic methodology, is not always observed by workers in the field. Land use, in Fox's terms, is the "actual and specific use to which the land surface is put,"[5]

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[4]James W. Fox, Land-Use Survey, Auckland, 1956, p. 42.

[5]Loc. cit.

while utilization is considered to be "land use applied to a specific objective".[6] The two terms are sometimes used interchangeably, or a writer may display a preference for either, without necessarily considering that land use and land utilization are not synonymous terms. No attempt will be made here to draw a sharp line between the two terms, because the critical nature of this study makes it necessary to consider writings which do not observe a differentiation between land use and land utilization. Land use (or sometimes land utilization) will here be considered in the sense of "present landscape cover,"[7] or the specific present use of land, which is usually reflected in its vegetal cover or lack thereof. Some works employ terms such as farming regions, natural regions, agricultural areas, or perhaps element-complexes, which generally correspond to Hartshorne's definition of "the synthesis of all features involved in the productive use of the land surface."[8] Fox refers to this as agriculture, and much of the available work on land use in Southern Africa occurs in such 'agricultural' studies.

A critical evaluation of the kind attempted here encounters difficulty because of the wide variety in type and quality of the work which it is necessary to examine.

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[6]Fox, op. cit.

[7]Richard Hartshorne, The Nature of Geography, Lancaster, 1939, p. 350.

[8]Loc. cit.

Uniformity of purpose and method is lacking, so findings may not easily be compared. Because objectives are not always clearly stated, an attempt will be made to derive them as far as possible from each study under review before the methods used are evaluated. Methods and means of data collection will be evaluated and compared as far as possible before the results are considered. The evaluation of each land use study will be based on the degree to which it has achieved its stated purpose. Once a critical analysis has been completed, an attempt will be made to compare and contrast the merits of different efforts. A desirable path for land use study to pursue in Southern Africa will be outlined in the conclusion.

3. The Contemporary Status of Land Classification

Man has always attempted to discover and assess his environment. After the haphazard collection of sometimes imperfectly understood facts about the land, the earliest formal attempts at classification were those of tax officials. According to A. B. Lewis,[9] one of the first classifications of land for taxation occured at Suhsien, in China, centuries ago. The eleventh century Doomsday Survey of Britain was an inventory of population, land, and livestock holdings in the newly acquired Norman territory, and employed methods of field

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[9]A. B. Lewis, "Land Classification for Agricultural Development," FAO Development Paper, No. 18, Rome, 1952, p. 7.

survey not entirely unlike those of modern geographers. Rhodesia's initial or Kraal Appreciation Survey in the development programme of the African reserves, under the Native Land Husbandry Act of 1951, bears a surprising resemblance to the Doomsday Survey.[10]

Man's curiosity about the land often stems from the awareness that all land is not the same, and any one tract may differ in one or more respects from another. Once this consciousness of variation is considered rationally, it may be organized into a classification. Of late, land use has been classified from many points of view, for many purposes, by many methods. A single all-purpose land classification is not feasible because natural, economic and social considerations vary widely, while possible uses may be quite different in different areas. An almost infinite number of land classifications exists for specific studies, but most of these may be grouped into a smaller number of types.

The purpose of classification, according to M. G. Cline, "is so to organize our knowledge that the properties of objects may be remembered and their relationships be understood most easily for a specific objective."[11] While Cline was principally concerned with soil classification, his statement is valid for any geographer engaged in investigation; further,

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[10]Barry N. Floyd, "Changing Patterns of African Agriculture in Southern Rhodesia," Journal for Geography, Vol. 1, No. 9, Sept. 1961, p. 7.

[11]As quoted by Fox, op. cit., p. 12.

it is essential that a classification be logical, well-organized, comprehensive, and easily understood. To avoid the danger of arriving at a mere inventory rather than a classification, objects must be grouped on the basis of their common properties.[12] The well-known example used in the National Resources Planning Board's publication Land Classification in the United States illustrates the point well: sand-dunes, beaches and marshes may all be part of a classification, but airfields and sand-dunes, being unlike objects, could only be part of an inventory.

Despite the long history of man's interest in the use of the land, and increased interest in encyclopaedic national surveys during the latter half of the nineteenth century, by the turn of the century land classification had not yet become a precisely defined systematic study.[13] The creation of a Land Classification Board in 1908 by the United States Geological Survey stimulated much work of a general nature, but it remained for a geographer, Carl O. Sauer, to recognize the significance of the land use survey. He published his findings in a paper in 1919.[14] He called for an improved "economic map" to eliminate confusion and over-generalization. Further, he stated that the "minimum essential of a geographic map is

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[12] Fox, op. cit., p. 12.

[13] Ibid., p. 2.

[14] C. O. Sauer, "Mapping the Utilization of the Land," Geographical Review, July-December, 1919, pp. 47-54.

that it shall portray the use to which the entire land surface is put."[15] Geographic techniques inspired by Sauer's work contributed to the 1922 Michigan Land Economic Survey, and the field has been developing ever since. Recognition that man's major resource is the land, and that it may be poorly used, misused, or ruined, has become accepted during the past half-century. The Dust Bowl crisis in the United States and the failure of the East African groundnut scheme were specific instances which pleaded most eloquently for better understanding of the land's nature and resources. Generally, increased population pressures and the wastage of resources have brought man to the awareness that the supply of land may be fixed, but its productivity need not be. Fox quotes the statement that "the land-use movement is the child of agricultural distress."[16] The 1930's witnessed a surge of interest in improved land use, as many persons sought to remedy the situation that had given rise to famine in the midst of plenty. Specialists in many fields, geographers, economists, pedologists, and agricultural scientists among them, undertook research into resource conservation. Hence, land use study did not begin as the realm of the geographer. Frequently teams of specialists worked together on large and small development projects involving land use studies. One such development

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[15]Sauer, op. cit., p. 48.

[16]Fox, op. cit., p. 3.

was that of the Tennessee Valley, under the Tennessee Valley Authority. While rural land use study was developing as a field of investigation, and its theory, aims and methods were being defined, urban studies were also advancing. In fact, the theoretical writings on urban land use are probably more voluminous and complete than those on rural land use. As a field, it also has attracted many workers besides geographers--sociologists, town planners, and business advisers among them. Rarely is urban and rural land use dealt with in the same manner or in a single study, however. Scale differences make it particularly difficult to deal with urban and rural use in one study.

With the publication of Land Classification in the United States in 1941, the National Resources Planning Board of the United States tried to introduce some organization into a field in which both the problems and the techniques employed in solving them change both temporally and spatially. This study, which was probably occasioned by the spurt of interest in conservation in the 1930s, set out to analyze the content of land classification. The categories which it discusses, therefore, are sufficiently valuable to be summarized here, even though they are not fixed or mutually exclusive, and do not claim to cover the field completely.

Five types of land classification were recognized, of which the first was "land classification in terms of inherent characteristics." This is concerned with the inherent physical

characteristics of such phenomena as soil, topography, subsurface features such as mineral deposits, climate, natural vegetation, and water resources. The importance of the features to be studied varies with the purpose of the undertaking, of course. Classifications of this first type may draw upon a multiplicity of criteria, using them individually or in association. Inherent characteristics often constitute the fundamental classification of land, especially in areas not long settled, where social and economic factors introduced by man still play a minor role. A great body of research of this type has been attempted, and much of it has been done by specialist scientists.

The second type of classification recognized was in terms of "present use." It is probably here that the geographer is likely to make his greatest contribution to land classification. This type of classification is concerned with "the actual and specific use"[17] of the earth's surface, and deals only with existing conditions. Chaos would result from an attempt to record every existing use on a single map, so a selective, logically arranged classification is essential. Surveys of this type are numerous and exist in most parts of the world, with varying degrees of completeness and complexity. Present-use classification almost always gains from being employed in association with studies of inherent land qualities. Its greatest utility is in long-settled areas, where the

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[17]Fox, op. cit., p. 42.

process of adjusting land use practices to the land over long periods has resulted, within a particular cultural framework, in something approaching optimum land use.

The third type of classification distinguished by the National Resources Planning Board is known as "use-capacity classification." This assumes a specific use, for which the land is assessed according to its potential productivity. A use-capacity map in terms of a single specified use is not valid in terms of any other aim: good recreational land may well be inferior cropland. Classification may be in relative terms, as in a map of defined grades of cropland, or in quantitative terms, showing the expected yields of a particular crop grown under defined practices. Further, use-capacity studies may delimit areas according to the practices necessary to bring about a desired result. Farmers generally apply a form of use-capacity classification when they decide what to produce on their land; scientific assessment should add both objectivity and improved techniques to this process. Both type one and type two classifications may be prerequisites for any type three study. It is now possible to detect successive stages of development for planning purposes in the progression of types of land classification.

The fourth type is land classification in terms of "recommended use," in which bodies of land are assigned to classes in terms of recommended use. It adds another stage to the progression of classification types, and it is at this

point that land classification moves into the realm of land use planning. G. V. Jacks has said that

> recommended use classification is not so much an actual classification of land, as the formulation of a land-use plan on the basis of inherent properties, present use, and capabilities of the land.[18]

Naturally, economic and social considerations may produce a demand for a certain type of land use, which will need to be weighed with land capability. According to the National Resources Planning Board, recommended use classifications have a broad objective in the promotion of long-term economic and social benefits through improved agricultural methods and practices.[19]

Land classification in terms of "program effectuation" envisages some form of action to put desired land uses into practice. This action may involve modification of, or a complete change in existing uses, and thus it involves decisions about the timing of changes, and decisions about their effectuation. These management decisions may be expressed in map form. This stage in the land planning process requires administrative and popular support as a rule, and it is easier to achieve whenever there is widespread acknowledgment of the value of planning in achieving "wise use of land resources."[20]

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[18]G. V. Jacks, Land Classification for Land Use Planning, Imperial Bureau of Soil Science, Technical Communications, No. 43, London, 1946, p. 11.

[19]National Resources Board, *op. cit.*, p. 7.

[20]*Ibid.*, p. 1.

None of the above types of land classification claims to be all-purpose, and few Southern African studies fit neatly into any one of the categories. Not only may the five stages be likened to stages in the planning process, but they frequently benefit from being used in conjunction with one another. Classifications drawn up to deal with specific problems often contain elements of more than one type. Further, since land use is constantly changing, no classification, however successful, will fail to benefit from revision and updating.

Much existing methodological work on land classification is concerned with the mechanics of mapping and survey, the fractional code notation being a case in point. Certain classifications embody so much precision that only highly-trained personnel can use them, while others are so simple that a schoolchild is able to handle them adequately. Much land use mapping is largely mechanical, once the methods have been tested. The interpretation of results, and the implementation thereof, are fraught with difficulties. Planning may involve decisions on the best combination of compatible uses for an area (multiple land use), or the recognition of a dominant use when several uses are present. It is essential that the director of the exercise in land classification be well aware of the problems he faces and of the most advantageous ways of overcoming them. Experience and familiarity with the works of others, while no substitute for original thinking and resourcefulness, are considerable assets.

CHAPTER III

PROBLEMS OF RURAL LAND CLASSIFICATION IN SOUTHERN AFRICA

Any research undertaking will encounter difficulties which demand solutions before the project can proceed satisfactorily. This is as true of land classification projects as it is of any other study. In this field of study, problems of two distinct types arise, although many difficulties have elements of both the theoretical and the practical. Certain land classification problems are methodological or theoretical, while others arise out of the actual process of classifying, and may therefore be called operational or practical. Unless methodological inadequacies are recognized, and the situation rectified, operational problems must multiply since the foundations of the structure are weak. There are, however, practical problems which occur even when the methodology is quite sound. Further, in addition to those general problems of land use work which may occur anywhere, certain difficulties are closely tied to the regional setting of the work; in the present case some problems of land classification are peculiar to Southern Africa, since they stem from local conditions. Other problems which are common in Southern Africa do also occur elsewhere, as comparative study will demonstrate later.

Problems of land classification apart, the actual farmer or other user of the land encounters limitations and handicaps which are closely connected with the physical environment.

1. Practical Problems

Consideration of existing work may be a guide to the problems facing the student of land use. Williams' map shows the recent (1960) state of land use mapping in the Republic of South Africa.[1] It demonstrates the concentration of work in three areas, accessible to the students of the University of the Witwatersrand, Natal and Cape Town. This concentration is to some extent explained by the fact that much survey work is done in the preparation of junior theses by individual students. The preponderance of this type of work underlines three practical problems: (i) the shortage of trained personnel to undertake such assignments, (ii) the absence of a programme of financial assistance for private work, and (iii) the difficulties of access to certain parts of the country. A further contributing factor to the emptiness of much of the map, is incomplete base map coverage on such useful scales as 1:50,000 or larger: the gaps are naturally most common in sparsely populated rural areas of small economic importance. It must be emphasized that while Williams did not indicate agro-economic and agro-ecological surveys on his map, such studies do cover all of the Republic of South Africa and

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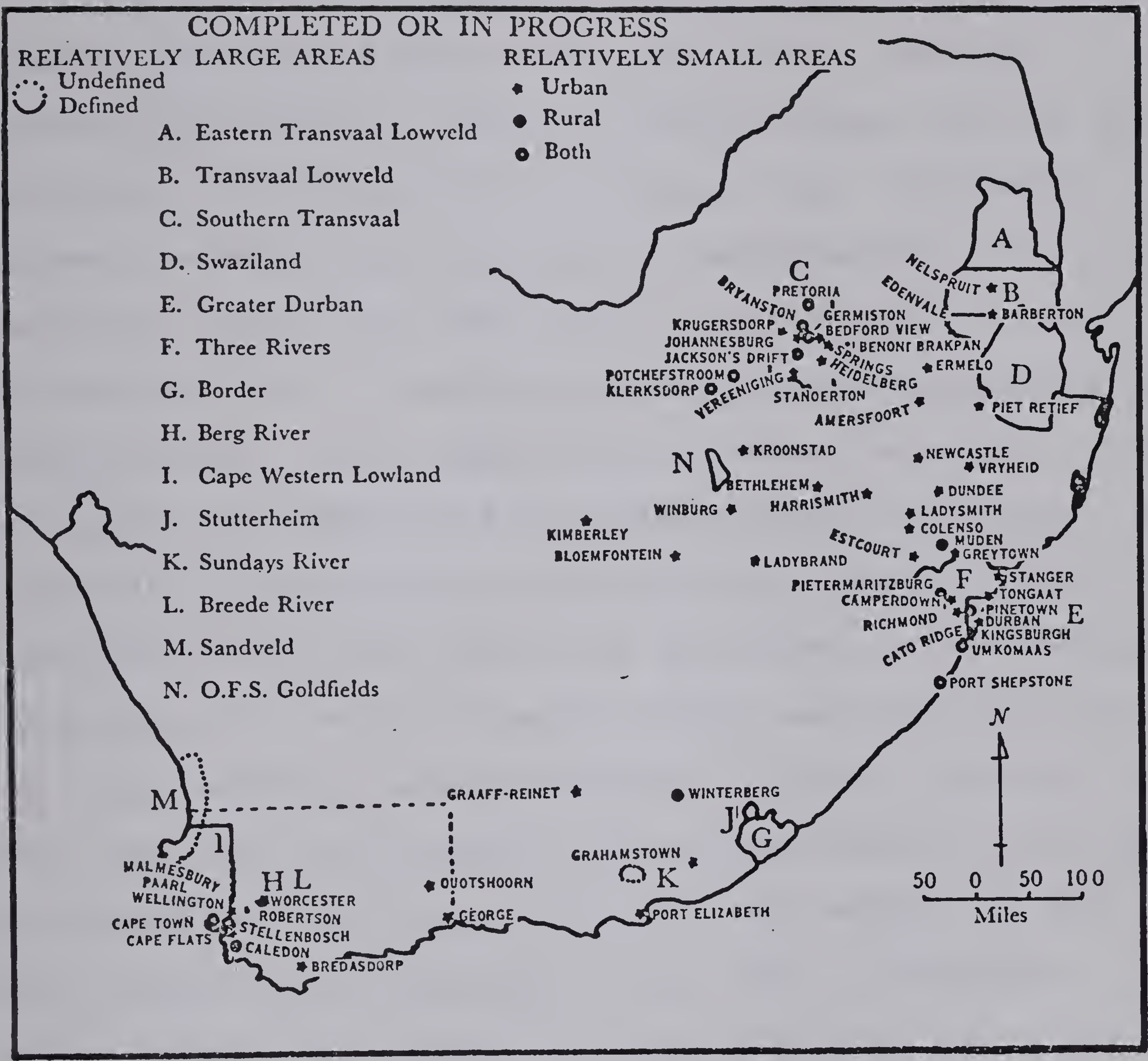
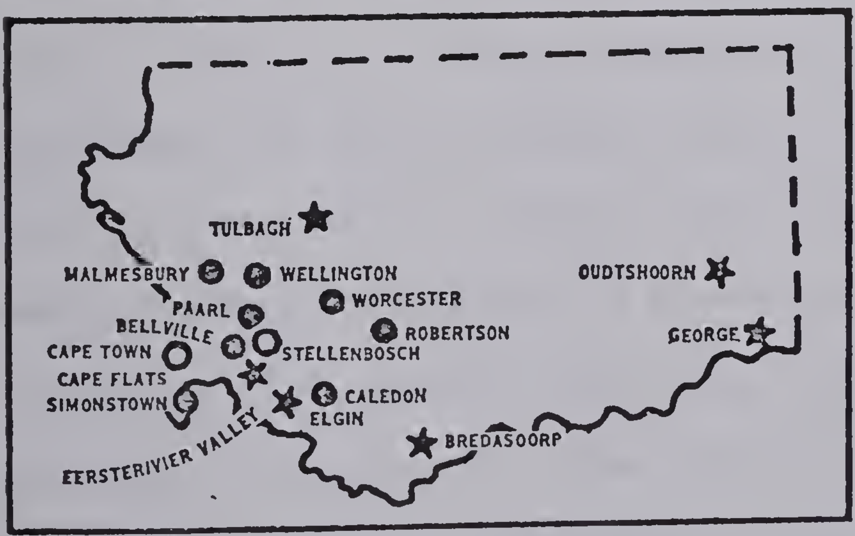
[1] O. Williams, "Land Use Mapping in South Africa," South African Geographical Journal, Vol. XLIII, Dec., 1961, p. 29.





LAND USE

MAPPING

IN

SOUTH AFRICA

Fig. 9.

From: O. Williams, Some Problems of Land Use Mapping in South Africa, South African Geographical Journal, Vol. XLIII, 1961, p. 29.

Rhodesia.

The primary operational problem of land classification concerns the persons who do the actual work: there is a shortage of trained or partially trained workers who are able to perform the mechanics of classifying land. University students, usually those attached to Geography Departments, are excellent recruits for this work: the University of Natal in particular has a vigorous student field-work programme in land use study. But a small body of student volunteers would be spread very thin if all of Southern Africa were to be mapped in any sort of land classification project. Other possible recruits could come from such groups as the teaching profession; the Swaziland sample survey used Swazi teachers and civil servants, who worked during a school vacation. In this case time was a problem, since these enumerators had to be trained for their task and do the work within the one month of the school vacation in July, 1960. In Southern Africa, despite the overall literacy rate being the highest for all Africa, a large proportion of the population is either illiterate or semi-literate, and so quite unable to comprehend clearly even such a simple land classification scheme as that used by school children in the Land Utilisation Survey of Great Britain. Although the work done in Swaziland was not total national coverage, but the mapping of selected areas, the organizers of the sample survey were hard pressed to find enough field workers. It is evident that the supply of

suitable field workers is limited, and the number of personnel trained to analyze survey results or interpret aerial photographs is extremely small.

Of late, aerial photography has proved invaluable to the land classifier, particularly where there is a shortage of suitable field workers. Classification from aerial photographs can be done for a large area by a handful of trained personnel, thus eliminating many problems of labour and communication.

> The value of air photography as an expeditious and economical means of mapping is particularly great in countries such as South Africa, large and sparsely settled countries that have possessed topographic mapping services for only a relatively short period.[2]

While Europe has long had excellent large scale topographic maps, the countries of Africa had few reliable, detailed maps prior to the widespread introduction of aerial survey methods, after the Second World War. Many of the former British territories in Africa, among them Basutoland (Lesotho) and Swaziland, were completely surveyed by air in the post-war period, with much of the work being done by the Royal Air Force. Botswana has been partially covered by ground and air survey, and Swaziland is presently covered by an excellent series of 1:50,000 maps, based on these post-war aerial surveys. South Africa witnessed the establishment of geodetic

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[2]W. J. Talbot, "The Use of Air Photographs in Land Use Mapping," South Africa Geographical Journal, Vol. XLIII, December, 1961, p. 76.

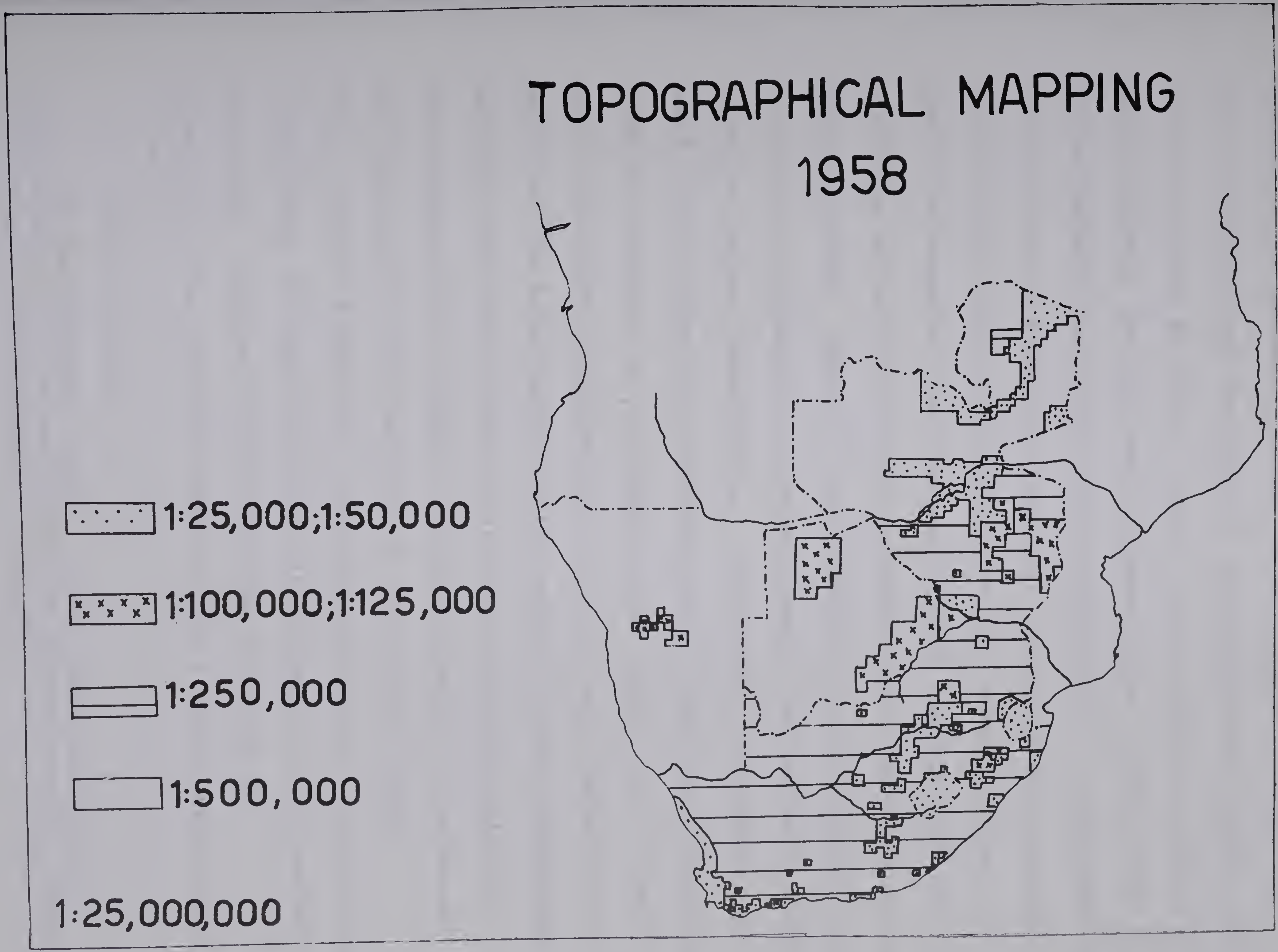

Fig. 10.

After Oxford Regional Economic Atlas of Africa, 1965.

triangulation in 1905, before the Act of Union united the four provinces, but the national Trigonometrical Survey only came into being in 1919. Because of the laborious system of ground survey, few maps were produced prior to 1936, when air survey methods were first used in the Union.[3] A good base map is essential to the land classifier and frequently provides him not only with an accurate start, but with a variety of useful information about the countryside and its land use. In addition, aerial photographs themselves are a survey tool for the researcher. Ideally, they provide a clear, objective image of an area, reflecting a precise moment, yet remaining available for future consultation. The trained interpreter can read a vast amount of information from a good set of photographs; --by the study of an individual print, by the use of stereo-pairs, and from a photomosaic. Although much depends on the skill of the interpreter and the quality of the photography, an approximation of those agricultural features which may be recognized at a range of scales is quoted in the Manual of Photographic Interpretation.[4] At scales larger than 1:10,000 individual crops and buildings may be correctly identified; at scales between 1:10,000 and 1:30,000 certain crop types, such as orchards and row crops may be identified, but at scales smaller than 1:30,000 only major

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[3]Talbot, op. cit., p. 76.

[4]E. H. Bomberger, et al, "Photo Interpretation in Agriculture," in American Society of Photogrammetry, Manual of Photographic Interpretation, Washington, 1960, p. 563.

land units such as cultivated fields, pastures and woodland may be recognized. The scale of photography at the land classifier's disposal depends on the primary use for which the photographs were taken. Unless special photography is taken for a land use study, at high cost, one must turn to available coverage. Most Southern African aerial photography has been taken for official cartographic purposes. For example, the Central African Federation was producing excellent maps from aerial photographs before the dissolution of the federation on December 31, 1963. Before the Second World War, the South African "Trigsurvey" used photographs on a scale of 1:20,000, flown at 10,000 to 11,000 feet; however, more than 200 of these photographs were required to cover one 1:50,000 sheet of the topographical series. Post-war survey planes flew at 20,000 feet, producing photographs at a scale of 1:30,000, fifty of which covered the area of one 1:50,000 sheet. But details of such features as minor soil erosion gulleys were lost, and could not be recalled by magnification.[5] It is possible that future South African aerial surveys may be flown at even smaller scales, at a saving to the Trigometrical Survey, but at a considerable loss to others interpreting the photographs for such purposes as soil and land use surveys. The periodic large-scale aerial photography done in parts of the United States and Canada seems far distant in Southern

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[5]Talbot, <u>op. cit</u>., p. 77. Much of the information for this section comes from Prof. Talbot's paper.

Africa, although officials of the South African Trigonometrical Survey have stated that photographs "could be prepared specifically for land use work if they received a request directly from a government department."[6]

Despite their great utility, aerial photographs have limitations when used for land classification. The scale may not be ideal for the interpreter's purposes, and the photography may not have been done at a time particularly suitable for interpretation of the agricultural situation: crops may have been harvested or the land may be fallow. A single crop may vary greatly in appearance on an aerial photograph, depending on its stage of growth, its health, the type of cultivation practised and other factors such as soil type and soil moisture. In addition, available Southern African coverage has not used the orthochromatic and infra-red emulsions which best reveal distinctions in plant cover.[7] Geographers making use of aerial photographs should beware of complete reliance on photography: some familiarity with the area is invaluable as a guide to what the photograph should reveal. Whenever possible, field checking of classification done at the desk is essential; fortunately this type of field work is much speedier than land classification done entirely in the field, since only problem areas have to be visited, once the worker is familiar with the area. A further

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[6]South African Geographical Journal, Vol. XLIII, 1961, "Discussion on Land Use Mapping," p. 32.

[7]Talbot, op. cit., pp. 76-7.

problem of rural classification is that of out-dated photography, as agricultural areas may change considerably in respect to the type of crops grown, methods of cultivation used and scale of undertaking. In Southern Africa, extreme climatic conditions such as drought may alter the land use pattern greatly in a short period, or a new irrigation scheme may change it totally. Nonetheless, an out-dated photograph is better than none at all, as it can be used as a base with changes recorded where they have occurred.

On the positive side, aerial photography may provide either an alternative for, or adjunct to, sampling procedures. Where an entire area cannot be mapped on the ground, sampling may be attempted, but selecting the proper intensity for this may be hazardous without detailed knowledge of the whole area.[8] In Swaziland, peri-urban areas were included by sampling in what should have been a rural study. Complete photographic coverage of a large area means that the worker can examine it all, identify the type of land use present and plan necessary field work.[9] Determination of quantitative measures such as the area of a particular crop is a relatively simple procedure in photo-interpretation, while measurement of irregular areas in the field is much more difficult. Annotated photographs are often used in field work, as they were in the Border survey. A further advantage of

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[8]Bomberger, op. cit., p. 601.

[9]Ibid., p. 602.

photographic interpretation is the way it reveals significant geographic relationships to the trained eye, for example, relationships between soil changes and crop changes. Such relationships may be extremely difficult to see, or to delimit accurately in the field.

Aerial photographic coverage provides at least a partial solution to several practical problems of land classification in the sub-continent. These are the problems of the shortage of suitable field workers, the difficulties of communication in sparsely settled districts and areas of broken topography, and the lack of complete map coverage in many areas. Since field checking cannot be eliminated, these problems still have to be dealt with, but on a much reduced scale.

2. Theoretical Problems

The theoretical problems of land classification lie at the heart of the field of study, and are the questions to be decided before any land use work is even attempted. If the methodological thought behind the study is confused or totally lacking, implementing the work will be difficult, and the results may be of questionable value. The standard questions of objective and methods should be carefully considered, and if possible a pilot survey should be used to test the chosen classification, its logic, its comprehensiveness, and the methods to be used. The purpose of the exercise, and the matter of correlating the classification with other work and possible future large scale surveys should be carefully

weighed. Consideration of the scale of the work, and the degree of detail to be included, are two related theoretical problems. In most cases rural land use can profitably be mapped at a scale smaller than that employed for urban use, since the use of such small individual units as buildings is not generally recorded; the units to be mapped are larger but the overall area is often large, too. The selected scale may range from the World Land Use Survey's recommended scale for final maps of 1:1,000,000, right to the scale of the excellent 1:18,000 maps which cover parts of Southern Africa. It is generally wise to conform to the scale of available maps and air photographs, in order to avoid endless reduction and enlargement of base maps or the setting up of new base maps. Contact prints of aerial photographs, which may be useful field charts, are commonly at the scale of 1:36,000 in South Africa, for instance; such a scale is easily converted to the 1:18,000 scale. Naturally the type of feature to be recorded, and the desired amount of detail are of paramount importance in selecting the scale of work. A further vital decision concerns the matter of whether dominant or mixed uses are to be recorded. Anyone who has attempted to reduce a large field sheet to a smaller final map has faced the problem of trying to show distinct uses which cover a small area. Where a variety of uses occurs in close proximity, reduction may demand the selection of the dominant use. But as the scale decreases it may be necessary to portray mixed uses to prevent

the loss of all small scale uses. This might be done by a series of stripes, their width being proportional to the area occupied by a particular use. Although such a method of mapping detracts somewhat from the clarity of the land use map, it could have advantages. Christopher Board suggested that a principle of portraying mixed uses might solve apparent contradictions in the World Land Use Survey Key, as applied in the African context, since woodland and grazing land could be mapped as related categories, which are not mutually exclusive.[10] If any attempt were made to map land use for a sub-continental area, the scale would probably be small, and a system of showing mixed uses might solve practical problems of indicating small use areas. It might also indicate common land-use associations.

It would be short-sighted to map only the present land use of a selected area, without considering the factors which underlie this use, particularly the physical factors such as geology, topography, soils, precipitation, temperature and natural vegetation. In addition the climatic and soil requirements of particular crops should be known, as should the incidence of pests and diseases. In short, a causal relationship between the actual use and the environment, plus economic and social factors, should be sought, and its adjustment considered with a view to possible recommendations or improvements. Naturally a good deal of technical data is necessary to provide

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[10]C. Board, "The World Land Use System and South Africa," South African Geographical Journal, Vol. XLIII, 1961, p. 20.

such a complete picture, and the land classifier should ascertain just what is needed, what is available, and what data have to be gathered. Since the African territories rarely have complete detailed soil, geological and other surveys available, the land classifier should decide what he needs and how he is going to get it before he actually starts mapping. A related problem is the conversion of existing statistics to the project's needs. In South Africa, for example, census and other statistics are presented in terms of magisterial districts of widely varying size, with all manner of curious boundaries. Furthermore, census categories change from time to time, introducing endless complications if an historical perspective is required.

3. Problems Peculiar to Southern Africa

Besides the basic practical and theoretical problems of land classification, certain factors influence Southern African land use enough to give rise to problems peculiar to the area. The most evident of these concerns the distinct thread which is always woven into the fabric of life in this part of the continent: the juxtaposition of different racial groups. Although Southern Africa's population is not divided simply into one black and one white group, the Asian and Coloured groups are not large-scale land-owners, thus they do not influence rural land use in any marked way at present. The major contrasts occur in the way the people of European descent and the members of the Bantu nation earn their living

from the land. Land tenure differences are the root of the contrasts in use, since the Bantu have a traditional system of tribal land tenure, while the Europeans have always had individual land ownership. It must be stressed that Bantu customs and practices have been modified by contact between the two groups during the past century. Nonetheless, in many Bantu tribal areas, reserves, locations[11] and Bantustans, a form of tribal tenure still exists. It is self-evident that a land owner using his property for his own benefit and for his heirs', will treat it differently from a man using land to which he has no personal claim, and where he has no security of tenure. Soil enrichment and protective measures, such as fencing and contouring, may well be absent under a form of communal tenure, though the degree of agricultural advancement will also be involved. Given the social and political system of South Africa and Rhodesia, it should be recognized that governmental authority to bring about agricultural reform and halt misuse of land is greater in Bantu areas than in White-owned areas. Government officials are able to forbid the use of given areas to the Bantu inhabitants of a reserve if this is deemed necessary in order to correct the ravages of incorrect use, and they may also cull an individual's cattle. Such measures would rarely be taken in "White" areas. Despite the existence of governmental powers of this kind, the co-operation

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[11]Locations are urban or peri-urban areas set aside for exclusive Bantu occupation.

of the local population is always sought first, and the inhabitants are encouraged to take the initiative to help themselves, while making changes at their own pace. The long-prevalent South African attitude of paternalism toward the Bantu is admirably illustrated by a quotation on the subject of rehabilitation of the reserves, which appeared in an official publication, comparing the Bantu Administration Department's role to that of "the schoolmaster who has to adapt his lessons to the pace of the slower pupils."[12]

Marked differences in land use may occur in an area which has fairly homogeneous topography, soils, climate and vegetation, simply because the groups living on the land have different ways of using it. The Bantu generally cultivate small patches, have little mechanization and little capital and tend to concentrate on subsistence agriculture rather than raise cash crops. European farmers, as a generalization, have large farms, more capital and more equipment, and perhaps more technical knowledge. On occasion Bantu groups succeed in making excellent use of their land, usually with the assistance of their agricultural officers, by making the most of plans for improved land use, agricultural training and various assistance schemes which enable them to acquire farm machinery, breeding stock and fertilizers. Changes in the racial groups occupying a tract do show in the mapping of the present use, and require different treatment in the planning stage, given the existing socio-political situation at the southern tip of

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[12]From The Official Yearbook of the Union of South Africa, 1956-57, quoted by C. Board, The Border Region, p. 146.

Africa. To date, official attempts to handle problems arising out of land use, such as over-stocking and soil erosion, have been handled according to the racial groups involved, rather than according to the agricultural problems. In the Republic of South Africa the problems of Bantu agriculture are handled by one government department and those of European agriculture by another, the entirely distinct systems of conservation districts underlining one aspect of this separation. Although the people may be separated socially, economically they remain interdependent, and the perpetuation of artificial barriers does not contribute to the optimum use of the nation's land resources. The Europeans of South Africa are dependent on the Bantu for labour, on their farms and in their towns, and the Bantu depends on the Europeans for a livelihood, since the areas reserved for the Bantu are presently not adequate in area or productivity to support all or even a majority of their inhabitants.

Another factor which affects the use of rural areas is government commodity control which operates largely through marketing boards in both South Africa and Rhodesia. In the Republic, such marketing or control boards were established in the late 1920's and early 1930's. The rationale for such action came from the demand for national self-sufficiency following the First World War, when the country became acutely aware of its isolation and its dependence on distant lands for foodstuffs and manufactured goods. Because of the

frequency of droughts, periodic floods and insect ravages, primary agricultural production fluctuated domestically; meanwhile prices for such produce fluctuated on the international market.[13] The marketing boards often maintained prices above those on the open market in order to encourage production of particular commodities. Marketing controls had some influence on the production of certain commodities, thus affecting production patterns. Notably in the cases of wheat and maize, the system of internal price support led to the cultivation of areas which were marginal for these crops. Areas with poor rainfall reliability were cultivated successfully in good years, but experienced crop failures in poor years, thus providing only the most precarious living for their cultivators.[14] This was especially true before the drought-resistant varieties of hybrid maize were introduced, as maize must have rain during a critical part of its growing cycle or the crop will fail. Another aspect of the subsidy system was monoculture, which impoverished the soil and spread crop diseases: wheat growing in the 1930's often damaged the soil and gave rise to widespread sheet and gully erosion, especially in marginal production areas. The control system has limited overproduction of some crops, and has centralized processing and marketing

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[13] Board, The Border Region, p. 147. Much of the material used in this section comes from this part of Christopher Board's book.

[14] Board quotes from the Social and Economic Planning Council, Future of Farming in Southern Africa, Pretoria, 1945, paragraph 20, in The Border Region, p. 147.

procedures in other areas. Its influence on land use is difficult to assess accurately even for a particular crop in a particular area because of the number of variables, but it has undoubtedly affected land use in both South Africa and Rhodesia. The existence of government controls is one more factor to be considered when evaluating present use of recommending future use, but its influence is not as permanent as that of soil type or topography.

The presence of endemic pests and diseases is an example of an environmental limit placed on land use. Apart from the anopheles or malarial mosquito, the tsetse fly is probably the insect which has most affected African development. It transmits both human sleeping sickness, which affects development indirectly, and trypanosomiasis of cattle, which has a very direct effect on regional development. Tsetse-infested areas cannot support cattle, and this is a severe handicap, particularly since so much of Africa should be excellent pastoral country. The presence of the tsetse fly inhibits the introduction of any balanced system of mixed farming as well. Severe as the tsetse fly problem is, Southern Africa is less affected by it than is the rest of the continent. Of the area under discussion the Republic of South Africa, Swaziland and Lesotho are virtually free from tsetse infestation. It is a limiting factor in Northern Botswana where the inland Okavango delta harbours the fly, and the danger of animal trypanosomiasis exists up to 400 miles from this

centre.[15] Sadly, the tsetse fly menace occurs in those wooded, well-watered areas which might have high development potential, since the insect breeds in shady woodland, and the disease is spread by wild animals which enjoy an environment suitable for domestic cattle. Another belt of infection follows the bush which fringes the Zambezi River. The only territory under consideration here which is severely handicapped by the fly is Zambia, with almost half its area falling in the "fly belt."[16] Other cattle diseases are of lesser significance, chiefly because they are epidemic in nature and can be controlled by stringent and well proved measures. Examples of these diseases are foot and mouth disease and rinderpest or cattle plague. Crop diseases and insect pests such as the maize stalk-borer, however, affect both the spread and the yield attained from crops, therefore exerting some influence on land use. Scientific advances and co-operation from the farming community should in time remove these temporary bars to development.

The difficulties encountered by the farmer are vitally important to the student of land use. Not only do these difficulties reveal much about the natural environment, they frequently indicate the possibilities for, and limitations of, agriculture in a given area. The most striking and wide-spread

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[15] L. P. Green and T. J. D. Fair, <u>Development in Africa</u>, Witwatersrand University Press, Johannesberg, 1962, p. 183.

[16] The source for this section is the <u>Oxford Regional Economic Atlas of Africa</u>, Oxford, 1965, pp. 104-5.

problem in all of Southern Africa is water supply, largely because the annual rainfall is not dependable, and is normally inadequate for most food crops, while the evaporation rate is high. Good farming land is scarce, for these reasons, and because

> the soils are generally poor, often thin and immature, and mostly lacking in mineral constituents and humus; because the plateau slopes are much broken in character and the river valleys deeply incised; and because in the tropical parts the tsetse fly is widely prevalent.[17]

Because of the scarcity of good farming land, land suitable for irrigation should be so used if the increased yields will justify the cost of irrigation. Amongst the areas which could benefit from the provision or extension of irrigation schemes are the Orange River valley, the lowveld of the Transvaal, Zululand, and Swaziland, as well as the Sabi River valley of Rhodesia, parts of the Zambezi valley in Rhodesia and Zambia, the Kafue Flats of Zambia and the Okavango delta of Botswana.[18] The major drawbacks to irrigation development are the high capital cost, the formidable rate of evaporation, particularly from open irrigation canals, the difficulty of finding large tracts of flat land near a source of irrigation water, and the high rate of siltation. The silt load of the Caledon River, which forms the boundary between Lesotho and the Republic of

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[17]Green and Fair, op. cit., p. 68.

[18]Ibid., p. 118.

South Africa, is 1.2 per cent by volume, for example.[19] The substitution of barrages for storage dams does minimize the accumulation of silt, by scouring during floods, but they cannot store as large a quantity as a major storage dam. Improved land use, and consequent lessened erosion, would do much to halt silting. One problem which is not as much of a drawback in Southern Africa as in other parts of the world is the quantity of labour required for the task of irrigating land. A question which must be carefully weighed before embarking on an irrigation scheme is the education and adaptability of the local population. While Botswana's Okavango River, for example, has a mean annual run-off of six million acre feet at the entrance to the swamp, an amount which could irrigate more than a million acres, this would require the transformation of peasant herders into skilled irrigation farmers,[20] in addition to the accumulation of quantities of pedological and hydrological information, and the establishment of a good communications network. This would be an irrigation scheme without parallel in Southern Africa, where the Vaal river only irrigates some 110,000 acres.[21] Incidental to the subject of irrigation is the link between run-off and soil

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[19] D. F. Roberts, "The Water Resources of South Africa. What of the Future?", appendix 3, p. 244, Thorrington-Smith, Toward a Plan for the Tugela Basin, Pietermaritzburg, 1960.

[20] Green and Fair, op. cit., p. 185.

[21] Roberts, op. cit., p. 244.

conservation; presumably as soil conservation measures proceed, more and more precipitation is utilized where it falls, and the run-off from the land decreases.[22] This would not be true of catchment areas where improved vegetal cover should result in an improved river regime. But better use of precipitation where it falls may well mean less water available in streams for irrigation purposes. However, reduced aridity means reduced need for supplementary water. Southern African rivers usually have seasonal flow, sometimes suffer severe flooding, carry a heavy silt load and are often incised; none of these factors encourages irrigation, but in a land so short of water every possibility should be explored. These few rivers which support viable irrigation schemes are a great asset. Of these, the Crocodile river of the Transvaal Lowveld, the Great Usutu of Swaziland, the Sabi River of Rhodesia and parts of the Zambian Kafue River are some which have lent themselves to irrigation.

Another problem faced by the farmer involves pasture quality. In a land so dependent on pastoral activity, veld management and conservation are matters of the greatest importance. For the major part of Southern Africa which lies in the summer rainfall area, natural pasture is nutritionally adequate during the early summer, unless overstocking occurs. The late autumn to early spring sees a widespread protein and

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[22]Roberts, op. cit., p. 247.

phosphorus deficiency for most of the summer rainfall area.[23] Supplementary winter feed is essential, but rarely provided, as it is customary to allow cattle to live entirely off the veld. So the need for spring grass is great, and often met by veld-burning, which is sometimes injurious to the natural vegetation.

An important consideration for the land classifier in Southern Africa concerns intensity of use. The worker must view the matter in its correct context in order to appreciate when optimum productivity has been attained, and what the limits are. There is a fair reflection of regional conditions in Wellington's consideration of "intensive arable" use as the "present or potential use at least 25% of the farm or land area for cropping."[24] Given the environmental difficulties of most of the subcontinent, impossible goals should not be set by the planner.

Broken topography, soil poverty, poor farming techniques, and pasture deterioration are among the problems besetting the agriculturist. But they should not be insoluble, and the land classifier and land planner should be able to identify the problems, trace their causes and attempt to indicate a better way of life through knowledge of the environment, in terms of both its potential and its limitations.

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[23] J. H. Wellington, Southern Africa, Vol. I, Cambridge University Press, 1955, p. 291.

[24] Ibid., Vol. II, p. 106.

CHAPTER IV

AN EVALUATION OF ATTEMPTS AT RURAL LAND USE CLASSIFICATION IN SOUTHERN AFRICA

Interest in land classification in Southern Africa first became apparent in the 1930's, not long after the land utilization survey of Britain had begun. There has, however, never been a survey of the entire sub-continent or its major territories comparable to that carried out in Britain. Many land classification studies have appeared for various parts of Southern Africa, but only the major ones and others of significance in the planning field will be considered here.

The first major land classification survey to be initiated was the "Agro-Economic Survey of the Union"[1] produced by the South African Department of Agriculture, for which fieldwork was begun in 1936. John H. Wellington's work on "Land Classification in Southern Africa"[2] first appeared in 1953, to be followed in 1962 by a potential use classification for Southern Africa, prepared by L. P. Green and T. J.

[1]Union of South Africa, Department of Agriculture, Agro-Economic Survey of the Union, Bulletins 270, 275, 289, 309, 320, 325, 335, 344, Pretoria, 1948 to 1955.

[2]J. H. Wellington, Southern Africa, Vol. II, Chapter 8, "Land Classification," pp. 104-115, Cambridge University Press, 1955.

D. Fair.[3] National studies have been completed for Rhodesia; viz., "An Agricultural Survey of Southern Rhodesia,"[4] and for Swaziland, with the report on the Swaziland Sample Survey entitled "Experiment in Swaziland."[5] Zambia has yet to produce a national survey, but a soil and land use survey of the Copperbelt appeared in 1956.[6] C. G. Trapnell also prepared papers on vegetation and soil relationships in Northern Rhodesia and on the soils, vegetation and agricultural systems of north-eastern Rhodesia.[6]

At the provincial level two studies of Natal will be discussed: one is "An Agro-Ecological Survey of Natal,"[7] while the other is a paper on "Land Use in Natal."[8] Regional studies make up the other material reviewed here. Christopher Board's work "The Border Region"[9] and the Natal Town and

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[3] L. P. Green and T. J. D. Fair, Development in Africa, Witwatersrand University Press, Johannesburg, 1962, pp. 66-73.

[4] Federation of Rhodesia and Nyasaland, An Agricultural Survey of Southern Rhodesia, Vol. I and II, Salisbury, 1961.

[5] J. F. Holleman (ed.), Experiment in Swaziland, Oxford University Press, Cape Town, 1964.

[6] C. G. Trapnell, et. al., Vegetation-Soil Map of Northern Rhodesia (with an explanatory memoir), Government Printer, Lusaka, 1948. C. G. Trapnell and J. N. Clothier, The Soils, Vegetation and Agricultural Systems of North-Western Rhodesia, Rep. Econ. Surv., 1936. Northern Rhodesia Department of Agriculture, Report of a Soil and Land-Use Survey, Copperbelt, Northern Rhodesia, Lusaka, 1956.

[7] J. A. Pentz, An Agro-Ecological Survey of Natal, Department of Agriculture and Forestry, Soil Conservation and Extension Series, No. 7, Bulletin 250, Government Printer, Pretoria, 1949.

[8] K. Buchanan and N. Hurwitz, "Land Use in Natal," Economic Geography, Vol. 27, No. 3, July 1951, pp. 222-237.

[9] C. Board, The Border Region, 2 Volumes, Oxford University Press, Cape Town, 1962.

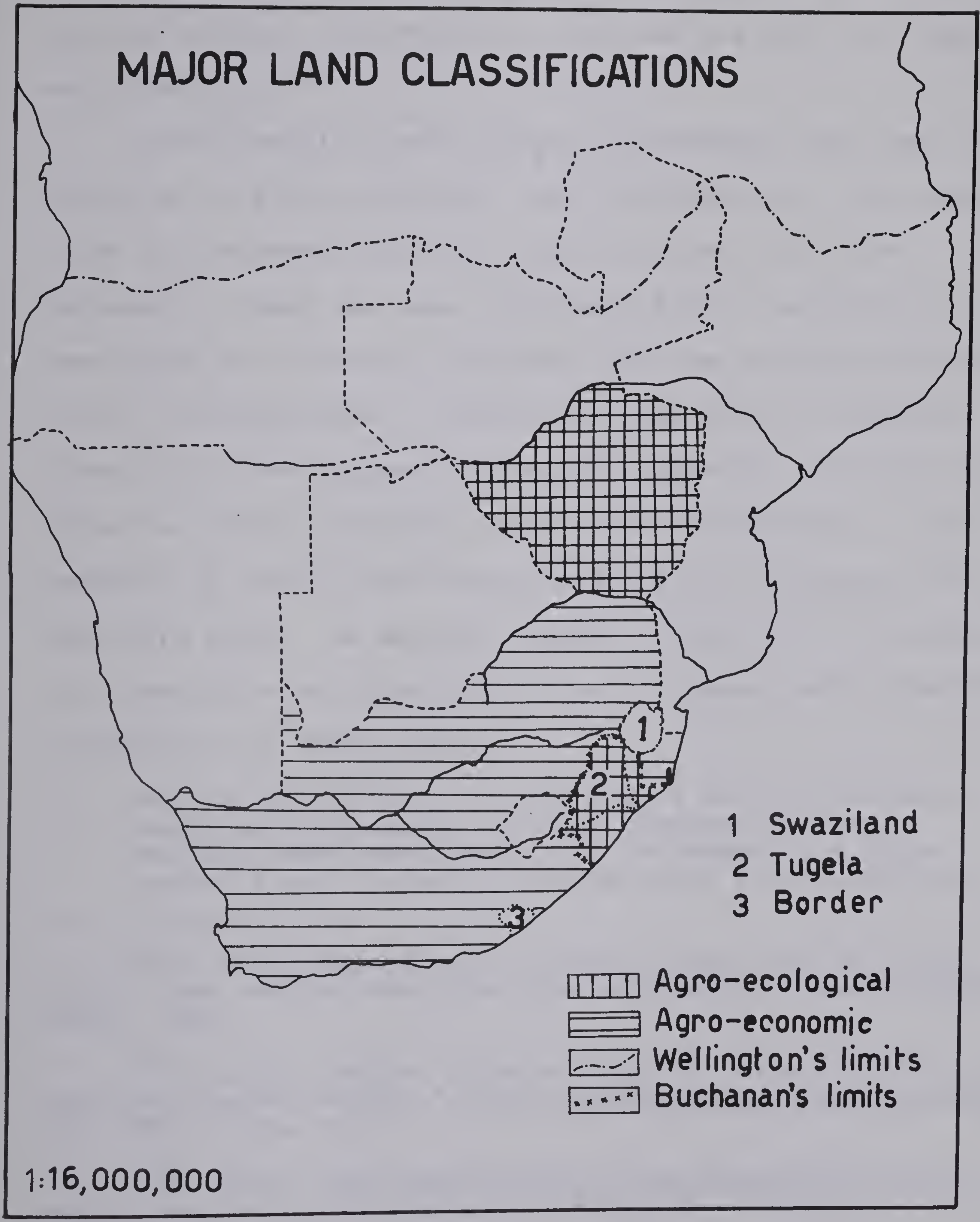
MAJOR LAND CLASSIFICATIONS
1 Swaziland
2 Tugela
3 Border
Agro-ecological
Agro-economic
Wellington's limits
Buchanan's limits
1:16,000,000

Fig. 11.

Regional Planning Commission's "Toward a Plan for the Tugela Basin"[10] are major regional studies. Among the lesser regional studies, two by Monica Cole and one by L. H. Impey are noteworthy.[11, 12, 13]

Traditionally, South African governments have been conservative in their policies. For the electorate, who happen to be a privileged minority, group interests are often paramount. There has been relatively little interest in developing the country's resources for the greatest advantage of all its population. Consequently the idea of national planning has not enjoyed widespread popularity although farm plans to assist individual farmers are not uncommon. The Republic of South Africa has had a Ministry of Pl-nning for less than five years. An extreme example of the lack of enthusiasm for planning of any kind comes from the report of a commission on education in South Africa:

> We are not, of course, proposing a kind of planning based on forecasting how many chemical engineers, and how many bricklayers will be needed in fifteen years' time, for such planning would be incompatible

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[10] E. Thorrington-Smith, Toward a Plan for the Tugela Basin, Town and Regional Planning Commission, Pietermaritzburg, Natal, 1960.

[11] M. Cole, "Elgin, Caledon District, Cape Province. A Land Utilization Survey," South African Geographical Journal, Vol. XXXI, June, 1949.

[12] M. Cole, Land Use Studies in the Transvaal Lowveld, World Land Use Survey Occasional Paper No. 1, 1956.

[13] L. H. Impey, "Land Use in the Upper Berg River Valley," South African Geographical Journal, Vol. XLIII, 1960.

> with our country's traditions of individual freedom . . . .[14]

South Africa's Natural Resources Development Council has produced a number of excellent regional reports on selected topics, reports which have been thoroughly researched and clearly presented. The Republican government joined the Johannesburg City Council and other bodies in requesting the 1958 planning survey of the Southern Transvaal, the great metropolitan area of Southern Africa.[15] The Government endorsed many of the recommendations of the Natural Resources Development Council's Southern Transvaal report. The urban development of the Orange Free State Goldfields also proceeded according to Natural Resources Development Council guidelines. Nonetheless the N.R.D.C. has not instituted, nor encouraged a national land use survey for the entire Republic, probably because its personnel and resources are involved in the study of problem areas, and a national survey lies beyond the Council's means.

Government leadership in the matter of a national planning survey encounters a major obstacle in the division of responsibilities between government departments. Different ethnic groups occupying the land are controlled by a variety of ministries, including Bantu Administration and Development,

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[14] Education for South Africa, the 1961 Education Panel, First Report, Witwatersrand University Press, Johannesburg, 1963, p. 31.

[15] Natural Resources Development Council, A Planning Survey of the Southern Transvaal, Pretoria, 1958.

and Coloured and Indian Affairs, as well as other departments. Individually, these departments, as well as those of Agriculture and Planning, do excellent work, but national co-ordination is absent from resource assessment, conservation and planning. The need for a national "stocktaking of resources" has been keenly felt since the Bantustan policy of the government was first implemented in the 1950's. The Tomlinson report was, in part, an evaluation of land and financial resources necessary to the ultimate success of this policy.

No South African university has the personnel or funds to undertake a national survey, nor has any society or foundation offered support for such a scheme. Consequently, the country has proceeded with only localized planning or none at all. Unguided use of the soil has had some disastrous results, as described for the Western Cape Province:

> . . . the malpractices which have destroyed so much soil, that have disfigured so many hundreds of square miles in this region alone, are so long established and so firmly rooted that most farmers appear to regard soil erosion as an inevitable concomitant of cultivation.[16]

All major land classifications for Southern Africa will be reviewed in this chapter. Because of its scope, and its 'pioneer' role, the first one discussed is:

(i) <u>The Agro-Economic Survey of South Africa</u>

The first national land classification for the (then)

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[16]W. J. Talbot, <u>Swartland and Sandveld</u>, A Survey of Land Utilization and Soil Erosion in the Western Lowland of the Cape Province, Oxford University Press, Cape Town, 1947, p. 50.

Union of South Africa was produced by the Department of Agriculture. Field work for this agro-economic survey began in 1936. Publication of reports on specific regions began in 1948, with reports appearing at irregular intervals from that time. The survey grew out of a need for correlated information about the physical characteristics and agricultural potentialities of the country.[17] Available information on the physical environment, and the annual agricultural census, by magisterial districts of varying sizes, had proved inadequate for the needs of agricultural officers, hence the survey was to assist those government departments concerned with the administration of agriculture, by aiding in the development of a co-ordinated policy, and by isolating particular regional problems. It was also meant to benefit individual farmers by making them aware of the characteristics and possibilities of their own areas and those of others, while helping to prevent serious mistakes in the choice of farming systems.[18] In addition, public and private bodies which form and implement credit policy were expected to make use of the survey's findings. It was not, however, envisaged as the first step in a national planning programme, so that the data collected were not organized in a form which could become the base for a land use plan. In fact, the type of

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[17] Key to the Agro-Economic Map of the Union of South Africa, 1951-2, p. 7.

[18] Agro-Economic Survey of the Union, Bulletin 270, Pretoria, 1946-7, p. 4.

information collected varied from region to region.

The purpose of the agro-economic survey was "to divide the Union into its most important agricultural regions."[19] The regions were to be reasonably homogeneous in terms of the most important physical, climatic and economic factors which have affected existing farming systems. Some generalization was undertaken to ensure that each agro-economic region was "large enough to be an important factor in the agricultural economic structure of the country."[20] In order to achieve regions which would, hopefully, change little in the course of time, emphasis was placed on those "natural divergencies"[21] which were considered to be responsible for the differences in farming practices rather than on differences in farming systems which result from factors likely to change in time, such as the presence of a temporary market.

Statistical data for the survey included information on farm area, area cultivated, crops grown, yield per unit, number of livestock, and grazing carrying capacity. Most of this information was used purely as illustrative material. A wealth of information on local conditions was supplied by agricultural officers. Regional differences were so minutely observed that seventy-six areas having different farming types

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[19] Key to the Agro-Economic Map, p. 8.

[20] Loc. cit.

[21] Loc. cit.

were differentiated. Current land use was not studied for this survey, apart from the tabulation of areas as irrigated lands, dry lands, native lands, old lands, and grazing lands. Carrying capacity of natural pasture was computed according to the farm area and the number of animal units actually kept. This could not be a true measure unless each farm was being used to its optimum capacity. No distinction was drawn between African-owned and European-owned land, but the previous absence of economic data for the African areas, where farming is often of the subsistence type, meant that such areas received less full treatment.

The South African agro-economic survey tried to provide a guide to the potential agricultural production of the country as it was revealed by natural phenomena. An important part of the survey was the collection of data about current farming systems. The agro-economic regions were chosen on the grounds of homogeneity of topographic, climatic and economic factors. The agro-economic survey, especially its expression in cartographic form--the Agro-Economic Map of South Africa--showed both the actual productivity and possibilities of different areas of the country. This survey set out to be a national assessment of farming resources.

The value of the survey is chiefly as a compendium of information. Attempts to conduct dual-purpose surveys encompassing both the current farming situation and future possibilities rarely succeed because the criteria for

measuring actual and potential use are not the same. A further defect lies in the agro-economic survey's failure to demonstrate causal relationships. Data were collected and tabulated, but no selective use of information was made to pinpoint problems requiring further study. Value judgments are suspect in a scientific study, and such judgments abound in the agro-economic survey, e.g., "this is a good farming area," or "the rainfall ensures fairly reasonable crops."[22] A great deal of detailed agricultural information about South Africa is contained in the survey, and much can be gained from the agro-economic map and reports. Poor direction and the absence of a clearly-charted course have reduced the value of this survey, however, to a point far below the similar one of Southern Rhodesia.

(ii) John H. Wellington: Land Use in Southern Africa (1953)

Professor Wellington produced the first land classification survey for the entire sub-continent. He defined Southern Africa as the entire area between the Cape and the Congo-Zambezi watershed, which included all the territories discussed in this paper. Wellington stated that "comparatively little of the sub-continent is well known agriculturally."[23] He then cited the work of J. A. Pentz, that of the Division of Soil Conservation and Extension (Union Department of

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[22] Agro-Economic Survey of South Africa, Bulletin 270, p. 41.

[23] "Land Use in Southern Africa," Farmer's Weekly, Sept. 2, 1953.

Agriculture) which produced the Agro-Economic Survey, and that of the Southern Rhodesian Department of Agriculture as sources for his preliminary land classification. Besides these major sources, Wellington drew upon his encyclopaedic personal knowledge of the area and upon a multitude of other sources, both published and unpublished. The classification was not intended for planning purposes. It was intended to be one aspect of a full geographical study of Southern Africa.

The productivity of the land was defined by Wellington in terms consistent with his knowledge of African conditions. Classes of use intensity were defined as follows:

Class I - land - intensive arable: the present or potential use of at least 25% of a land area for cropping.

Class II - intensive pastoral: cropping subsidiary to stock, with one stock unit (one large beast or five sheep) to about six acres.

Class III - semi-intensive: about 10% arable land, while the remainder is largely pastoral, having a carrying capacity of one stock unit to every six to ten acres.

Class IV - extensive: almost entirely pastoral, carrying one stock unit for every ten to twenty acres.

Class V - ultra-extensive: more than twenty acres to the animal unit.[24]

These five classes of use intensity are linked to the land classification key of the map produced by Wellington.

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[24]"Land Use in Southern Africa," loc. cit.

Class I land, although classified into three sub-types, has one common feature: it is all intensive arable land, where at least twenty-five per cent is used for cropping. The number in the key reflects the class of intensity to which the use belongs. The complete map key is as follows:

IA. Summer crops with cattle and sheep.
IB. Tropical and sub-tropical crops.
IC. Fruit and winter crops.
II. Cattle, dairying, with summer crops.
IIIA. Cattle with crops.
IIIB. Cattle with sheep with crops.
IIIC. Crops under irrigation, with cattle.
IVA. Cattle ranching.
IVB. Sheep and goats, cropping with irrigation.
IVC. Infested with tsetse fly or other nagana carriers; subsistence cultivation.
VA. Cattle ranching where water available.
VB. Sheep farming (nomadic).

At no time was a study of land use for any part of the sub-continent designed specifically for this study, nor was the classification designed to deal with a particular problem. The criteria employed were varied:

> the basis of such a survey must be what is already known of the potentialities of the land by actual experience coupled with what is known of the natural vegetation, the climate and the soils in areas where reliable experience is lacking.[25]

The classification was based on these factors, productivity, and the type of use "to which it (the land) is being or may be put."[26] The resulting land classification map reflects the methodological uncertainty of attempting to show both potential and present land use without distinguishing one

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[25]"Land Use in Southern Africa," loc. cit.

[26]Loc. cit.

A map of Southern Africa's land classification. I is intensive arable land, with I A summer crops and cattle and sheep, I B, tropical and sub-tropical crops, I C, fruit and winter crops and cattle and sheep; II, intensive pastoral with cattle, dairying, sheep and summer crops; III, semi-intensive arable and pastoral, with III A, cattle and crops, III B, cattle, sheep and crops, III C, crops under irrigation and cattle; IV, extensive pastoral and arable, with IV A, cattle ranching (w) winter pastures, (s) summer pastures, IV B, sheep and goats and cropping with irrigation, IV C, subsistence cultivation; V, ultra-extensive pastoral, with V A, cattle ranching where water available, V B, sheep farming; VI, desert. Irrigation areas are: 1. Vaal-Hartz, 2. Middle Orange River, 3. Great Fish River, 4. Hartebeestpoort, 5. Loskop, 6. Kamanassie, 7. Sundays River, 8. Olifants River. Potential irrigation areas: A, Okovango Delta; B, Banda and Chicoa Flats; C, Orange-Fish-Sundays Rivers; D, Sabi-Lundi Rivers; E, Zululand scheme. F, forest; G, major game reserves; TS, woodland infested with tsetse fly (after F. N. Bonsma). H, is the Etosha Pan, which is shown in its new shape after a recent survey.

Fig. 12.

From: J. H. Wellington, Land Use in Southern Africa, *Farmer's Weekly*, Sept. 2, 1953.

from the other. No distinction has been made between what IS there and what the author felt SHOULD be present.

Another difficulty about classifying land by correlating existing information is the lack of uniformity in available studies. Several sources for different territories exist in fields such as soil survey. For example, van der Merwe's soil classification for South Africa evaluates both lithological and climatic factors, while Ellis in Rhodesia relies on lithological factors alone. Moreover, much of the available information was out-of-date when Wellington prepared his classification, making it difficult to show current conditions entirely accurately. Perhaps because of the number of sources used, his references are incomplete, and his figures are sometimes quoted without reference to their source or date. Wellington's classification added to the geographical knowledge of the area by correlating and organizing much information that is normally difficult to obtain. Its principal disadvantage is the confusion between current and potential use. Wellington's expectation that modification of the classification would occur in time might be realized by the production of two separate classifications, one of actual, and one of potential land use in the sub-continent.

Wellington's land classification differed from the agro-economic survey by selecting types of farming, then showing their distribution, rather than studying the agro-economy of individual regions. The classification process was more highly developed and less haphazard because the national area

was assessed (or measured by a particular yardstick) before parts were assigned to pertinent categories. He reduced the number of regions recognized, from seventy-six agro-economic regions to eleven land classification regions. His classification was also much more logical than the agro-economic one, since it dealt exclusively with types of farming, while the earlier national survey produced regions differentiated by location, climate, vegetation, and type of farming. Consequently, Wellington's work can be considered a great advance on the agro-economic survey in terms of organization, the use of a logical classification system, and overall clarity. It is unfortunate that methodological confusion between actual and potential use should have much reduced the usefulness of this classification.

(iii) L. P. Green and T. J. D. Fair: Land Resources of Southern Africa (1962)

A second land classification for Southern Africa considered land resources as "the soil and natural vegetation which taken in conjunction with natural elements such as climate and topography, yield varying potentialities for farming and forestry."[27] These resources were not considered *per se*, since it was decided that Wellington, Cole and others had dealt with them adequately in existing geographical works on Southern Africa. Land resources were considered indirectly by

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[27] L. P. Green and T. J. D. Fair, *Development in Africa*, p. 66.

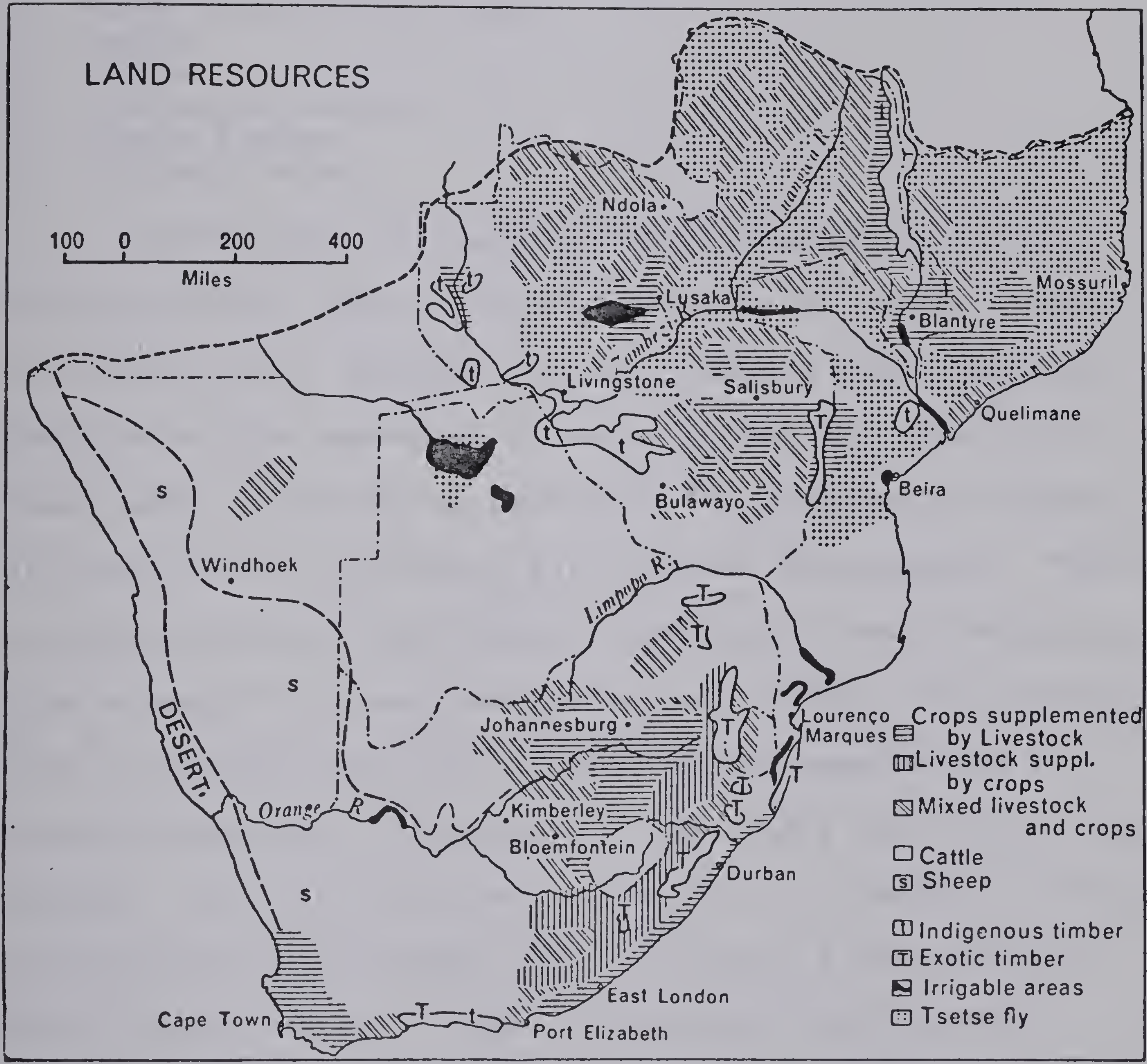

Fig. 13.

From: L. P. Green and T. J. D. Fair, Development in Africa, Witwatersrand University Press, 1962, p. 67.

examining the pattern of their potential use for agriculture and afforestation.[28] Agro-ecological analysis formed the basis for this potential use classification under the following categories:

1. Crops supplemented by livestock.
2. Livestock supplemented by crops.
3. Mixed livestock and crops.
4. Cattle.
5. Sheep.
6. Indigenous timber.
7. Exotic timber.
8. Irrigable areas.

A high degree of generalization characterized this classification, since it was intended to be merely a guide to resource use. Natural resource regions were formed by correlating the essential elements in the distribution of land, water, and mineral resources.[29] Each region showed a distinct natural potential for economic development. The seven resultant regions were ranged according to their potential. This attempt to assess pure potential, without the consideration of current land use, is too largely generalized for planning purposes, although it is admirable for the authors' purpose. It is an excellent guide for the student of African geography and development, and could bear a considerable amount of expansion, to make it suitable for planning.

(iv) <u>K. Buchanan and N. Hurwitz: Land Use in Natal (1951)</u>

This paper was occasioned by the fact that Natal has

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[28]Green and Fair, <u>op. cit</u>., p. 67.

[29]<u>Ibid</u>., p. 69.

long been regarded by South Africans as their "garden province," but Buchanan and Hurwitz found it was actually nothing of the sort. Buchanan and Hurwitz set out to demonstrate the geographic realities of the situation, and to suggest improvements.

Field traverses and annual agricultural censuses provided most of the material for this study of Natal. Buchanan and Hurwitz outlined the productivity pattern, and the general land use (or more properly, type of farming) regions of Natal. Agricultural productivity and potentiality were determined by the distribution of factors which limit development, principally climate and relief. Soil is of lesser importance since its depth and ~~moisture~~ drainage relationships are largely a function of relief, while fertility can be improved artificially. A sieve map revealed which areas are adversely affected by steep slopes, low rainfall (less than thirty inches per annum), and a prolonged dry season of more than four months. This showed that much of Natal suffers from difficulties of relief and/or climate. Those areas affected by all three limiting factors could be marginal farming areas, requiring soil conservation measures, drought-resistant crops, and acceptance of the land's low carrying capacity. With the use of the map of limiting factors and by the evaluation of soil, site and climatic factors, a tentative land classification and productivity map was produced. Land quality was

characterized thus:

I. Good quality land - "Can be cultivated permanently and safely with the production of moderate to high yields of adapted crops without special practices."[30]

II. Medium productivity land - "is suitable for cultivation with special practices; e.g., contour tillage or selection of drought-resistant crops."[31]

III. Land of limited productivity

Because of the scale of mapping, much of the province had to be shown as a complex of more than one type. Only one-twentieth of Natal emerged as dominantly good quality land according to Buchanan and Hurwitz's criteria. Optimum utilization of this limited area is extremely important to the entire community.[32]

The most important features of the province's agricultural emphasis were found to be: the concentration on production of carbohydrates, principally sugar and maize or corn, and the contrast between the coastal belt and the interior. The economy of the coastal belt is based on sugar-cane and cattle, that of the interior, on corn and cattle. Yet neither region was homogeneous, and the province could be divided into a number of land use regions, "each characterized by a particular assemblage of crops or a particular type of livestock husbandry."[33] Regional

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[30] Buchanan and Hurwitz, op. cit., p. 227.

[31] Ibid., p. 228.

[32] Loc. cit.

[33] Ibid., p. 230.

differences were found by applying such criteria as the total amount of land cultivated, the intensity of production of staple crops, and the type of subsidiary agricultural production.[34] Medium to low productivity was found to be the rule rather than the exception in Natal. The province does not meet the nutritional requirements of its population, so Buchanan and Hurwitz advocated increased food production. To achieve this expanded output, three measures were suggested: a general assessment of productivity and suitability for various types of land use, a programme of present use surveys, and an evaluation of the gap between the population's nutritional needs and existing production.[35]

This study of land use in Natal is valuable insofar as it demonstrates the actual productivity and potential of the province's land resources. Too much stress was laid on the need for nutritional self-sufficiency, since the area studied is of course not an independent entity, but a province within a larger state. Full realization of the area's agricultural potential should be the goal of the student of land use, but self-sufficiency is not vital in each political unit. The necessarily high degree of generalization limits the usefulness of this study to that of reconnaissance. Planning could proceed only after much more detailed and intense study, preferably in the field. The recent programme of land use

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[34] Buchanan and Hurwitz, op. cit., p. 230.

[35] Ibid., p. 222.

surveying in Natal, undertaken by the University of Natal, has not yet achieved uniform coverage of the province. The sieve technique of isolating factors limiting agricultural production is useful, and might be applied to all of Southern Africa in order to learn something about agricultural potential. This technique also lends itself to the defining of multi-purpose development regions, as in Fair's work.[36]

(v) Land Use Studies of Zambia (1936, 1943, 1956)

Zambia alone of the major territories reviewed here has as yet produced no national agro-ecological, agro-economic, or present land use survey. Its land use problems are very similar to those of other Southern African territories, especially those problems arising out of the transition from subsistence to scientific agriculture. Studies of climate-vegetation-soil relationships have been made by C. G. Taylor and others. The "Copperbelt," a chain of mining centres, was the focus of a soil and land use survey which appeared in 1956. In order to select suitable areas for agricultural development, information about soils, vegetation, and climate was gathered, while economic data were used to measure the success of current farming techniques, their suitability for prevailing conditions, and future prospects for farming on the Copperbelt. The "Copperbelt Report" contains relevant

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[36] "Regions for Planning in South Africa," South African Geographical Journal, Vol. XXXIX, December 1957.

information on the topography, climate, vegetation, and soils of the area. The reconnaissance soil survey relates soils to geological formations, uses natural vegetation as an indicator of soil fertility and estimates the agricultural potential of Copperbelt soils. Despite the allusion to a land use survey in the paper's title, land use was neither surveyed nor mapped: the report deals with physical factors and economic conditions, not land use _per se_. It is essentially a reconnaissance survey, not a plan to guide the use of land resources. Survey methods were said to be standardized, so that uniform methods could be applied in all future Zambian land classifications.

(vi) _An Agricultural Survey of Southern Rhodesia (1961)_

By far the most thorough and organized land classification produced for any Southern African territory is that done for Rhodesia by government agricultural experts. The agro-ecological and agro-economic aspects of the survey are integrated. This survey came into being because agricultural officers felt the need

> for a survey to determine more accurately the agricultural potential of Southern Rhodesia, to outline and classify regions differing according to the natural limiting factors of climate and soil, and to compile a clear picture of the varying farming potential."[37]

When the survey was set up in 1950, its objectives were stated

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[37]_An Agricultural Survey of Southern Rhodesia_, Vol. I, p. 1.

thus:

> (a) to identify and demarcate natural land use regions and areas, that is, regions and areas which may be classified on the basis of inherent physical characteristics, such as climate, soil, and topography;
>
> (b) to assess potential outputs from such areas in terms of the commodities for which they are best suited;
>
> (c) to explain and report upon the agro-economic regions, areas, and units which form the existing farm pattern, and to assess current normal outputs therefrom;
>
> (d) to examine the major land use problems.[38]

The members of the survey team included an agricultural ecologist and a pedologist, who assessed the potential arable land available, the stock-carrying capacity of the natural pasture and suggested the most suitable type of farming for particular areas. The third member was an agricultural economist, whose chief concern was the existing farm pattern. A pilot survey was undertaken to develop suitable methods and techniques and to solve problems of data presentation. Government officers from a number of departments collected much of the material for the survey,and supplied a great deal of supplementary information, while a committee of senior civil servants directed the study. The Southern Rhodesian survey was well-organized, and its results should be most suitable for guiding sound development and future agricultural policy. It is regrettable that similar projected

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[38]An Agricultural Survey of Southern Rhodesia, loc. cit.

surveys for Nyasaland (Malawi) and Northern Rhodesia (Zambia) were not produced during the lifetime of the Central African Federation, when the Rhodesian one was being undertaken.

The Southern Rhodesian report is in two volumes. These reflect the division into agro-ecology, where natural factors affect land use and determine agricultural potential, and agro-economy, where the present farming pattern is of a more or less temporary nature.[39] A disparity exists in territorial coverage, however. The agro-ecological study covers the entire territory, irrespective of boundaries between European and Bantu areas, while the agro-economic studies exclude all Bantu areas. Staff shortages were responsible for this deficiency, which was recognized as such by the directors of the survey. A presentation of facts without analysis about Bantu agriculture was offered in an attempt to offset the shortcoming. Almost half the territory was thus not adequately covered by agro-economic survey. The deficiency is serious because many of Southern Rhodesia's land use problems arise out of the varying ways in which different groups use natural resources, and an admirable opportunity for the objective study of the causes and effects of these difficulties in resource use was lost.

While the aims of the South African and the Rhodesian agro-economic surveys were to some extent similar, their methods and techniques differed considerably. Both tried to assist

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[39]An Agricultural Survey of Southern Rhodesia, op. cit., p. 3.

non-subsistence farmers to choose productive farming systems attuned to natural conditions, while also providing information for such projects as well-planned soil conservation schemes. But the Rhodesian agricultural survey alone was intended as a basis for planning and guiding future development. To give its classification more than transient value, emphasis was placed on those relatively unchanging physical characteristics which affect farming systems. In the ecological survey, a framework of natural regions and areas was set up to cover the country. A natural region was defined as "a relatively large area where agricultural development is, and will be, conditioned by one or a few dominant characteristics."[40] Throughout Southern Africa, the most dominant characteristic, the one having the greatest effect on land use, is likely to be adequacy and efficiency of rainfall. J. S. Peake, a Rhodesian meteorologist, produced a map of zones of rainfall efficiency for the territory by computing effective rainfall on the basis of average annual precipitation, estimated run-off and a drought factor. After anomalies were found in the course of the ecological survey, Peake revised his scheme to include a temperature factor. His contribution was invaluable to the ecologists. Natural areas generally covered those soil differences which affect systems of land use. The natural vegetation was also closely studied in order to recognize key indicator species and plant associations.

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[40] Introduction to the Agricultural Survey, p. 3.

The agro-economic regions were concerned with common patterns of land use, which resulted from the interplay of natural and economic factors.

The Rhodesian ecological survey relied upon the basic concept that ecological interpretation of the natural vegetation is a convenient and reliable means of assessing the systems of land use appropriate to a region, particularly one that has not been settled long. Pentz's earlier work in Natal was founded upon the same premise. Natural plant cover is seen as "a result of all the growing conditions where it is produced. It is an index or measure of the factors influencing its growth, and serves as an indicator of the possibilities of producing other plants on the land."[41] Where short-lived plants are concerned, present environmental conditions may be fairly well reflected in the species found. The ecological survey set out to provide the necessary information to determine the optimum land use for every part of Rhodesia.

Of considerable importance from the planning standpoint is this study's assessment of arable and grazing potential of the land. Arable land is defined as "land which has an adequate depth of soil for satisfactory plant growth, and which can safely be cultivated, using normal rotations, cultural practices, and protection methods."[42] Field assessments of

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[41] Agricultural Survey of Southern Rhodesia, Part I, p. 31 - quotation from Weaver and Clements, Plant Ecology.

[42] Ibid., p. 43.

potential arable land were combined with independent figures from local sources, to produce a mapped pattern which was found to reflect detailed topographical differences. In those areas where cropping is of importance, the percentage of potential arable land was arranged into seven classes, from more than seventy per cent to less than five per cent arable. Potential farm grazing land was assessed by calculating the area of available grazing and the average carrying capacity of the veld in terms of livestock units. Such an estimate does not account for grazing provided by arable land or such factors as supplemental feeding.

An assessment of agricultural potential is fundamental to the long-term planning of all development--agricultural, industrial and commercial. Besides this assessment, the Rhodesian survey defined and discussed the most important factors affecting arable and pastoral production. These include the length of the growing season, the adaptation of varieties, the tree-grass balance, endemic animal diseases, and the influence of irrigation of intensity on land use.

The excellence of the Rhodesian agricultural survey stems initially from its sense of purpose. The people who advocated the survey and those who produced it were alike convinced that optimum land use was a desirable aim, and, further, that the key to achieving this was full knowledge of the environment, its possibilities and its limitations. They found an ecological approach invaluable because the land

had not been settled long by cultivators, thus the natural vegetation might reveal far more about the environment than existing use did. Present use was also recorded and evaluated so that the sum total of information about the potential of the land and its present use provided a guide to well-adjusted systems of farming. The effectiveness of land use planning in the betterment programme of the Rhodesian Native Land Husbandry Act has been demonstrated. Application of the national survey findings should extend the benefits of planning to the entire country, not to the Bantu or non-Bantu areas alone.

(vii) The Swaziland Sample Survey of 1960

Problems of economic development and the effect of the impact of rapid change upon the traditional Swazi way of life made the territory's administration aware of the need for preparatory research. One suggested project was an investigation into Swazi land tenure in relation to the present political and social structure. When a geographer at the University of Natal elected to do active research in Swaziland, the project increased in scope. Once Swaziland agreed to participate in the 1960 World Food and Agricultural Survey, a major survey was born. It encompassed demographic, land use, and employment surveys.

This recent land classification of an entire Southern African territory represents the culmination of a vigorous programme of research into land use. Swaziland's Department

of Land Utilization, staffed by geographers, has been active in local surveying and planning. It assisted in the 1960 sample (or sampling) survey, but the constituent surveys of demography, land use, and employment were actually undertaken by the University of Natal's Institute for Social Research, on behalf of the Government of Swaziland. Since considerations of finance, time, and personnel made it impossible to cover the entire territory, sampling was used. The geographical sampling technique chosen produced 52 randomly selected squares having sides of 3 kilometers, plus 8 specially selected squares. These eight areas were chosen because their human geography and land use pattern were expected to show special characteristics. Some selected areas were on Swaziland's borders, one was in Lifa Land (former European-owned land bought by the Swazis and held in trust by the Paramount Chief for the nation), and one was in a planned land settlement area.

During 1959 a pilot survey was done. Upon its completion the results were carefully analyzed so that basic concepts, techniques, pitfalls and successes might be appraised. One result was a decision to make the greatest possible use of stereoscopic aerial photographs, despite the cost of a special aerial survey. This decision was initially a response to the problem of measuring irregularly shaped cultivated fields. Once the photographs had been taken, accurate land use mapping and area measurement were completed in the Department of Land Surveying of the University of Natal, with only limited field

checking. Aerial survey made faster and more accurate work possible, while providing a permanent record of the face of the land at one period in time.

Owing to the varied nature of the country and the diversity of its ecological conditions, four major physiographic strata were incorporated in the sampling pattern. Harm de Blij's physiographic classification, as modified by G. Murdoch, was used.[43] The four regions are roughly parallel, running from south to north; reading east to west they are the Highveld, Middleveld, Lowveld, and the Lebombo range. Analysis of the survey results produced regional contrasts which justified the selection of physiographic regions as primary units for the survey. Physical patterns supported these regional divisions,with respect to such features as climate, slope and soil. Among the survey's conclusions was the view that patterns of land utilization have evolved in response to the needs of people within a particular environment:

> The Swazi are by tradition a pastoral people, but the different patterns of land use have been determined not only by this tradition and such factors as population distribution, the need for basic food crops and the early development of the practice of shifting cultivation, but also by the contrasting conditions imposed by the physical environment in each of the four physiographic regions of the territory.[44]

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[43] Journal for Geography, Stellenbosch, September, 1960, Vol. I, No. 7.

[44] Experiment in Swaziland, p. 214.

Aerial photographs on a scale of 1:24,000 were used to produce the final maps. Land use maps of all sample areas on a scale of 1:6,000, showed the following categories of land use:

(a) Cultivated Land
(b) Fallow Land
(c) Plantations (wattle)
(d) Natural bush and scrub
(e) Marsh
(f) Unproductive Land (rock outcrops and erosion)
(g) Grazing[45]

Tables drawn up to list the quantities of each land use type became a source for the analysis of Swazi use patterns.

The chief achievement of the land use survey was its provision of reliable answers to the question "are the Swazis producing sufficient food for their requirements?"[46] Swaziland participated in the 1960 World Food and Agricultural Survey, under the auspices of the United Nations Food and Agricultural Organization. This required information was:

(a) whether people produced enough staple crops for their own consumption,
(b) what was the extent of their shortage,
(c) how big was the surplus.[47]

Because of the sampling technique used, the extent and distribution of all cultivation could not be measured, nor could the exact acreage under each crop, or yields per acre be ascertained. The total area under cultivation in surveyed

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[45]Experiment in Swaziland, <u>op. cit</u>., p. 56.

[46]<u>Ibid</u>., p. 204.

[47]<u>Ibid</u>., p. 10.

areas was calculated, and figures from other aspects of the survey used to determine the average area cultivated per person and per homestead. Crop averages and yields were estimated in the same way, the task being made easier by the dominance of maize (corn) in Swazi agriculture. Regional land use patterns were analyzed, then crop husbandry was discussed in terms of what is grown, the sufficiency of staple crop production, factors affecting the growing of maize, and ways of increasing agricultural production. Livestock economy was another major topic, particularly with respect to overstocking, its causes, effects, and remedies. Further conclusions were that the Swazi are "cattle-owners with very little knowledge of animal husbandry,"[48] so livestock problems loom large. The two problems of maize shortage and overstocking are intertwined, and action to relieve one problem will probably affect the other.

While this socio-economic study of the Swazi in his homeland was not intended to be either solely or chiefly a study of land use, it affords an excellent illustration of the ends such a study can serve in a wider context. Specifically, the land use survey revealed the present state of agriculture, the adequacy of domestic food supplies, particular problems of land use, and the areas of greatest population pressure. Accurate, well-documented information is of vital importance to a country desiring major development. The areas

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[48] Experiment in Swaziland, op. cit., p. 236.

of greatest need have been identified and assistance should be applied where it will bring the greatest benefits. Considering the limits of available funds and personnel for this survey, Swaziland has been provided with an excellent basis for planning its development. The land use worker may miss an overall land use map of the whole territory, since only sample areas were mapped, but the very complete tabulated information is probably more important to the planner. The usefulness of the Swaziland survey is testified to by Murdoch: "Sustained and varied use has been made of Prof. Holleman's findings within Swaziland since they became available, chapter by chapter, from early 1962 on."[49]

(viii) Christopher Board, The Border Survey (1962)

This study of natural environment and land use was one part of a survey which also investigated economic and sociological aspects of a region. The study covered two magisterial districts, East London and King William's Town, which together make up the "Border" region of the Republic of South Africa, so-called because it was for a long time the frontier between the old Cape Colony and the territory of independent Bantu tribes. "The area is not in any sense a natural region,"[50] it is a region of convenience. South African agricultural

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[49] G. Murdoch, "The Swaziland Sample Survey, 1960," South African Geographical Journal, Vol. XLVI, p. 41.

[50] Board, op. cit., p. 1.

statistics are reported for magisterial districts, and the two chosen districts cover the entire catchment of the Buffalo River. Transition is the key-note of the "Border" region--it is transitional in structure, climate, and in its sociological forms.[51] The patterns are, and have long been, very diverse. About thirty-five percent of the area is reserved for the Bantu at present, while the remainder is owned by Europeans. Here, South Africa's two main population elements have established "separate, contrasted, yet interdependent economies."[52] A mosaic of rural and urban economies in the towns, farms and native reserves exists:

> The co-existence of these three [i.e. towns, farms and native reserves] interdependent economies has resulted, in the rural sphere, in a great diversity of land use and farming type, a diversity that can be traced primarily to the different origins and cultural traditions of the people, to the character of land tenure including the sizes of farms, and to the variability of the natural environment.[53]

The Border survey was intended to be an inventory of natural resources, which also dealt with the stage reached in the development of resources by examining the use of the land.[54] Official statistics were inadequate as a measure of resource development, because the units (magisterial districts) for which they were given were too large to show significant

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[51] Board, op. cit., p. 1.

[52] Ibid., p. 3.

[53] Ibid., pp. 3-4.

[54] Ibid., p. 229.

spatial variation. The region's natural resources were discussed in terms of such factors as geology, climate, vegetation, settlement and transportation patterns. Then the land use of the area was discussed, broken down into its elements, which were the categories of the modified World Land Use classification, and resolved into regions possessing a certain uniformity of use.[55] The ready-made World Land Use Survey classification was used because time was too limited to permit a pilot survey and the testing of a tailor-made classification. This was believed to be the first African survey which conformed to the World Land Use Survey scheme, although the scheme had to be somewhat modified to overcome local difficulties. Changes in the colour key were made in the interests of simplicity and clarity in colour printing; the predominance of veld used for grazing led to the choice of buff to show such unimproved pasture, as it was a good background colour for coloured maps.

I. Original World Land Use Classification[56]

No.	Category	Colour
1.	Settlements & associated non-agricultural land	red
2.	Horticulture	deep purple
3.	Tree and other perennial crops	light purple

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[55] Board, *op. cit.*, p. 170.

[56] C. Board, "The World Land Use System and South Africa," *South African Geographical Journal*, Vol. XLIII, 1961, Table I, p. 2?.

4a.	Cropland, continual and rotation cropping	dark brown
4b.	Cropland, land rotation	light brown
5.	Improved permanent pasture	light green
6a.	Unimproved grazing land, used	orange
6b.	Unimproved grazing land, unused	yellow
7a - 7f.	Woodland (several subtypes)	green
8.	Swamps and marshes	blue
9.	Unproductive land	grey

II. Border Modification of World Land Use Survey Classification

1a, 1b.	Built-up areas	red
1c, 1d.	Associated non-agricultural land	orange
2.	Horticulture	deep purple
3.	Perennial crops, including orchards and bananas	magenta
4.	Arable land, with fallow	brown
5.	Improved permanent pastures	light green
6a.	Veld (unimproved pasture), used for grazing	buff
6b.	Veld not used for grazing	yellow
7a.	Dense forest and plantations of exotic trees	dark green
7b.	Cut-over forest	
8.	Marshes, not used for grazing	blue
9.	Unproductive land, sand dunes and bare rock	grey

A land use map, at 1:125,000, was drawn from the aerial photographs (1:20,000) and maps (1:18,000) used by field

workers. The chosen land use regions would become units, or areas of one land use type, if the map were reduced to the scale of one to one million, as recommended for the World Land Use Survey. This fitted in well with the World Survey scheme. It would make it simple to add the Border region to a small scale world map of land use. Board speculated on the underlying causes of the area's land use patterns before presenting his conclusions. Much of what he said is relevant to the study of land use throughout the Republic of South Africa, making this study of planning and controls affecting land use one of the most significant parts of Board's work. He stressed that settlement in the Republic has always been affected by state racial policy. In the Border region cadastral maps demonstrate the marked difference in land tenure between Bantu and European areas: individually-owned European farms contrast with the persisting tribal land tenure of the Bantu reserves. Board also included in his Border survey an outline of the resource conservation movement in the Republic.[57]

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[57]The South African resource conservation movement gained ground after the second world war, resulting in several pieces of legislation. European owned land is affected by the Soil Conservation Act of 1946, while Bantu areas are governed by Proclamation 116 of 1949, which regulates "betterment" or conservation schemes. The aims of betterment are, briefly, soil stabilization and land reclamation. The Bantu authorities exercise considerable power in their implementation of betterment schemes, which generally aim at "a planned economy based largely on mixed farming," according to Board. European farmers are encouraged to participate in soil conservation schemes, but participation is voluntary rather than mandatory.

In its author's view, the Border Survey's contribution to South African land use surveys "lies in its scope combined with the attempt to provide detail by sample studies of land use regions and farms and estates within these regions."[58] A representative farm was studied to discover the characteristics of each land use region. If the land use of the entire Republic could be mapped by some convenient method, the experience gained in the Border survey might be very profitable, particularly since the World Land Use code proved workable in this study. However, mapping an area of 1,547 square miles is a very different task to mapping half a million square miles. Sampling techniques, based on the use of aerial photographs, might be the only solution, as Board suggests.[59] A national survey might well demonstrate close ties between European and Bantu-owned land and refute popular opinion about their separateness. "A comparison of the uses made of similar resources under different cultural and economic conditions would be both revealing and important to the general

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For the entire catchment, white and Bantu areas alike, there is a Buffalo Soil Conservation Area, its chief purpose being to eradicate undesirable agricultural practices, while encouraging positive conservation measures. "The eventual aim was to increase the productivity of the land when it was stabilized at the level which would ensure the permanence of maximum productivity." (Board, p. 143) Besides large conservation areas such as the Buffalo catchment, smaller districts having particular problems receive planning guidance and government financial assistance in order to set up soil conservation works, such as dams and fencing.

[58] South African Geographical Journal, Vol. XLIII, p. 22.

[59] Ibid., pp. 25-26.

economic development of regions in the Republic."[60] Board felt that the World Land Use classification would provide a "sound basis for physical planning,"[61] but it is possible that an ecological approach might be a more accurate reflection of physical conditions than a study of the actual use, although man's profound alteration of natural vegetation may have somewhat reduced the value of ecological surveys.

The Border survey demonstrated that a present land use survey could be undertaken in Southern Africa provided that (1) trained field-workers could be recruited; (2) research funds could be found; (3) good base maps and/or aerial photographs were available, and (4) communications were fair. The World Land Use Survey scheme served as a usable classification, requiring only minor modifications. All the important elements of the region's land use pattern were revealed by the application of this classification, in conjunction with the study of physical features, historical, economic and social forces. The survey plainly bears the stamp of a geographer in its direction, content, and presentation. As an example for a general national survey it is excellent, provided some acceptable means of sampling could be devised, since the cost and manpower requirements of a national field survey covering half a million square miles would be prohibitive. Furthermore, a detailed survey of the entire national

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[60]South African Geographical Journal, op. cit., p. 22.

[61]Loc. cit.

area would be faced with too many cartographic gaps. The Border survey produced a detailed and complete picture of present land use, and thoroughly evaluated the underlying causes and influences. It produced no plan and did not attempt to do so--resource evaluation was its aim, and that aim was fulfilled. If the potential use of the area were also assessed, Board's work on present use would be valuable in the formation of a complete plan.

(ix) <u>Toward a Plan for the Tugela Basin (1960)</u>

As the title suggests, this is an interim report for this important river basin, a sub-region within the Republic. The government policy of decentralizing industry in South Africa is closely bound up with the planned development of the Bantu homelands or Bantustans. The Tugela Basin has considerable industrial potential and there are a number of Bantu reserves within its boundaries, thus it is a vital area in terms of the implementation of government policy. The basin is one of the country's most promising sites for industrial development because of its water supply, ample available coal reserves, proximity to reserves of labour, and its situation athwart the country's busiest road and rail links between the Witwatersrand and the port of Durban. Nevertheless, it is apparent that most of the basin's 11,200 square miles must remain in agricultural use, hence a thorough resource evaluation is essential. When work on the Tugela plan (by the Natal Town and Regional Planning Commission)

began in 1951, it was found that much necessary information was not available. Consequently, several original research projects were undertaken to fill these gaps. The report outlines the progress of, and co-ordination between, these projects.

For full industrial and agricultural development, the realization of the land's potential was considered to be all-important. Since the Tugela study needed to determine this potential, two research projects were initiated, one in plant ecology and one in soil survey. The objectives of the plant ecology survey were:

I. "To determine in detail the extent of the various types of plant community and to record the information on a suitable map."

II. "To ascertain the principal physical and biotic environmental factors, such as climate, soil, topography, fire, human and natural agencies, which control and affect the vegetation." ("Work done in the region indicates that the secondary effects on vegetation due to the activities of Man have had a more profound influence than the other factors . . . .")[62]

More detailed knowledge of the character and distribution of soils was thought necessary for this study, in order to correlate vegetation studies with environmental conditions.[63]

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[62]A. W. Bayer, "Memorandum on the Plant Ecological Survey of Natal," in Thorrington-Smith, Toward a Plan for the Tugela Basin, p. 36.

[63]Ibid., p. 37.

C. R. van der Merwe's map of the Union's soils at 1:5,000,000[64] was found to be of little use because of imprecise soil type boundaries and the absence of all intra-zonal soil types.

Three stages of the Tugela soil survey were:

I. Photo-analysis to demarcate similar or associated soils.

II. Construction of a semi-detailed map of a key area to familiarize the field staff with soil characteristics and to find the relationship between regional distribution of soils and air photos.

III. A routine reconnaissance survey of the Basin, culminating in a 1:100,000 map of soils.[65]

Land types were distinguished as part of the Tugela study. Each had a particular association of land forms, vegetation, land use, and soil erosion patterns. These land types were:

A. Coastal region (below 500 feet)

B. Thornveld (500 to 3,000 feet)

C. Sandy Sourveld - Northern Basin (3,000 to 4,500 feet)

D. Tall Grass Veld - Southern Basin (3,000 to 4,500 feet)

E. Highland Sourveld (above 4,500 feet)

This interim report on the Tugela Basin showed a concentration on ecological and soil surveys, in order to assess the area's potential. Special studies on the quality and

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[64] C. R. van der Merwe, Soil Groups and Sub-Groups of South Africa, Department of Agriculture, Pretoria, 1941.

[65] Thorrington-Smith, op. cit., p. 39.

quantity of the Basin's waters, and on such economic aspects as railway rates and competition from established industrial areas, were also commissioned in order to provide a balanced view of the area's potential and possibilities.

Because all the needed information was not available when the interim report was prepared, no attempt was made to present even a tentative plan for the Tugela Basin. The report sought to gather and correlate all available information in order to make the region's potential better known to the public, to stimulate interest in development of the basin and to begin to evolve the lines which planning should follow in the future. Even the flexible plan envisaged as the final report of this study was not outlined.

Analogies may be drawn between the Tugela project and the work of the Tennessee Valley Authority. Certain reservations must be made, however. The Tugela is not a river system of the magnitude of the Tennessee, and it is wholly contained within one province, Natal, so its problems of administrative co-ordination are minor, despite the usual division into European and Bantu sectors. Problems of flood control, navigation and power generation are of a different order to those of the Tennessee Valley. But the lessons of thorough resource evaluation, overall planning and the development of a regional consciousness among the people have been well learnt since T.V.A. was set up, and the Tugela plan should reap the rewards of such experience.

There are two major differences between the Tugela study and the Border survey: the Tugela report aims at the production of a regional development plan chiefly concerned with the area's suitability for industrial development. The Border survey did not produce a plan, nor did its investigations concentrate on one particular aspect of the area's potential use.

In its final stage, the Tugela plan will be more far-reaching than any other land classification project in the Republic. It is the only one which aims at a real development plan based on scientifically determined potentials. It is an excellent example of co-operation between planners and specialist scientists, working to provide a full picture of the region's potential. It also has a good chance of implementation since its initial premises are in accordance with government policies. Nevertheless, this report is an interim one, and the final plan may fall short of expectations. Recognition of the valuable work which may be done by a planning commission is a promising sign for the future of South Africa.

(x) J. A. Pentz: An Agro-Ecological Survey of Natal (1949)

Just as the Dust Bowl crisis gave impetus to the study of land classification in the United States, so the disastrous droughts of 1932 and 1933 led South African farmers to appeal for government-sponsored investigation into problems of soil,

water and vegetation conservation.[66] One result was the assignment of J. A. Pentz, a government scientist, to the Estcourt area of Natal to prepare a botanical survey. He "conducted studies correlating current farming practices with the occurrence or absence of soil erosion."[67] In 1943 he produced an agro-ecological survey of Natal showing vegetation types, laying down in it principles which determine the degree of intensification of farming which can be effected in the various veld types without damaging the soil.[68] He also drew on his experience to prepare a preliminary agro-ecological map of the entire Union of South Africa (1947).

Pentz advocated a co-ordinated country-wide plan of soil conservation into which individual schemes must fit, since not only are the causes of soil erosion inter-related, but areas are dependent on each other in terms of farming systems, size of holdings and the price of land. In order to arrive at an integrated system of types of farming potentially well-suited to defined areas, Pentz considered a national agro-ecological survey essential. Such a survey should cover two kinds of information: (a) knowledge of vegetation, soil and climatic conditions, and (b) knowledge of the requirements of different kinds of stock and crops.

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[66]Thorrington-Smith, _op. cit_., p. 99.

[67]_Loc. cit._

[68]_Loc. cit_.

Areas suitable for different types of farming could then be distinguished. Pentz's preliminary agro-ecological map of South Africa divided the country generally into extensive, semi-intensive and intensive farming areas, each of which was sub-divided into vegetation regions.[69] To Pentz extensive farming was totally dependent on the veld or natural pastures, semi-intensive farming presumed some possible use of arable land, and intensive farming demanded cultivation in order to maintain stock in good condition. Emphasis on pastoral activities is strikingly evident, because South Africa is overwhelmingly a pastoral country in terms of its rural use.

A recent assessment (1960) of Pentz's influence is a testimonial to his efforts:

> During the last few years farming activities in the Tugela Basin have been intensified to a marked degree, broadly on lines conforming to Pentz's principles. Close attention to the ecological limitations of the various veld types as applied to land use has proved of immense benefit and has been of considerable assistance in the formulation of farm plans. The advantages accruing from the application of these principles are now manifest and have led to a growing interest on the part of the farmer in the structure of the soil and the nature of the vegetation it supports.[70]

It is significant that, despite the increasing concern of Governments the world over with planning, this interest on the part of the Southern African farmer should have been so long delayed.

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[69] Pentz, op. cit., (1949).

[70] Thorrington-Smith, op. cit., p. 100 (1960).

(xi) The Native Land Husbandry Act, Rhodesia

The problems of insufficient food production and over-population in Southern Rhodesian African areas became apparent in the early years of this century, and by 1933 the first programme of planning for the reserves was under way. This "centralization" programme involved the division of native reserves into arable land, grazing land, and planned village sites. The programme was gradually implemented until it was interrupted and superseded by the Native Land Husbandry Act of 1952.[71] "This Act provided for the control of the utilization and allocation of land occupied by Africans, and for ensuring its efficient use for agricultural purposes... ."[72] It aimed at the protection of natural resources, the promotion of good land husbandry and the limitation of stock to an area's carrying capacity. Under it, holdings are allocated to individuals, usually the heads of families, at a standard rate of approximately six arable acres and sixty acres of grazing, unless the area concerned suffers from sufficient population pressure to modify these figures.

The method of land classification used in the implementation of the Native Land Husbandry Act is a form of potential use classification, still known as centralization. The land

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[71] Agricultural Survey of Southern Rhodesia, Part II, The Agro-Ecological Survey, p. 95.

[72] Ibid., p. 96.

classes are distinguished as follows:

Class I. Arable land, on the more fertile soils, is limited to slopes of less than twelve per cent, "as this is the upper limit of land slopes on which contour ridges of adequate capacity can be built and maintained economically."[73]

Class II. Grazing land: those areas better suited for grazing, because of their fertility or topography.

Class III. Forest land, generally on steep slopes.

Class IV. Waste land.

Throughout the administration of these areas, attempts have been made to integrate traditional systems of agriculture with the requirements of conservation farming.[74] A land use plan is formulated by a Land Development Officer, then it is put into effect by the Officer in cooperation with the area's inhabitants. The first step in implementation is the division of arable land and grazing land, with conservation works, like contour ridging, providing the next step in the arable areas. Land is allocated to kraals in blocks, before individuals receive their individual lots. Grazing rights are allocated according to the land's carrying capacity, before areas are divided for rotational grazing management, scrub is thinned and other measures taken to improve carrying capacity.[75] Once the Land Husbandry Act has been implemented

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[73]Agricultural Survey of Southern Rhodesia, op. cit.,p. 99.

[74]Loc. cit.

[75]Loc. cit.

in the Bantu area, a Reserve Plan is produced to guide future development.

In Southern Africa as a whole, the need for prompt and widespread improvement of Bantu agriculture is undeniable. Since hasty action before resource evaluation may create more problems than it solves, a programme similar to that established for the Rhodesian Native Lands is desirable. The preliminary survey, supervised plan implementation and projected future reassessment of the areas are essential to such a programme's success. Community acceptance is vital too, and the Rhodesian authorities have attempted to make the measures acceptable to Bantu people, principally by involving them in the planning and the execution of the plan. Agricultural demonstrations by members of the local community seek to give the inhabitants confidence in the new measures.

B. N. Floyd has outlined the system of land use and prevailing settlement patterns which the 1952 Act set out to alter and improve.[76] Aerial photographs are used to trace the implementation of reforms: outlying kraals are regrouped, scattered parcels of arable land and pasture are replaced by more compact, effective holdings, and improved agricultural practices such as contour plowing become evident. Floyd questions the speed at which changes are occurring, since even the urgency of the problem of limited and deteriorating

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[76]B. N. Floyd, Changing Patterns of African Land Use in Southern Africa, Syracuse University, 1960. Abstract in A.A.A.G., Vol. 50, 1960.

African lands cannot condone hasty implementation of remedial measures. But action of this kind on a national scale is providing a more suitable foundation for African agriculture in Rhodesia. The benefits of improved farming, in cooperation rather than conflict with prevailing conditions, should be increased productivity and greater yields which will raise the general standard of living over a period of years. This Rhodesian programme is similar to the Betterment measures taken in South Africa, but it is more purposefully implemented. Its aim is to improve every African area in Rhodesia. This is an example of land classification and planning in action at the present time, while most land classification in the sub-continent has been academic rather than practical. Each African area is assessed, then planned as a whole in order to improve the inhabitant's standard of living and reduce the misuse of the land. The haste of implementation may be a drawback, but the processes of land classification and planning are being put to work to improve land use, and to involve the farmer.

Conclusion

Besides the large scale studies of land classification in Southern Africa there is a wealth of smaller scale studies, both published and unpublished. The most notable feature of these papers is their individuality--they use no common classification and their objectives are varied. The quality of the work also varies, but these studies are usually of

small areas selected arbitrarily for academic exercises in land classification. They have contributed little to the progress of planning in the sub-continent, but they have amassed a good deal of detailed geographical information in an organized way. The previously mentioned studies by Cole and Impey are among the best of this type. Certain of these surveys could be regarded as pilot studies for certain classifications. Some of their findings might in time be utilized in a large scale land classification project.

It is notable that the largest and most advanced territory in Southern Africa, the Republic of South Africa, has yet to produce a full inventory of national resources. Such an inventory should precede a plan for the conservation, development, and rehabilitation of resources on a national scale. The Agricultural Survey of Rhodesia is an inventory of this type. One can only speculate on the reasons for this deficiency. It is possible that the Agro-Economic Survey of South Africa might have become a valuable resource evaluation, had its approach been more carefully reasoned, its direction firmer, and its work done by a trained team of land classification experts. Instead, an army of workers amassed vast amounts of information, which was not well-correlated in presentation. Another possible reason for the backwardness of South Africa in the field of resource inventory is the dichotomy between European and Bantu affairs in the administrative field. This cleavage between the two groups has always been more

pronounced in South Africa than in Rhodesia. Its results show in the number of projects concentrating on the land of one particular group, while ignoring others. The Betterment programme for Bantu areas is such a project. The ultra-conservatism of the Europeans in South Africa has not produced a milieu receptive to the ideas of planning--free enterprise is greatly valued--hence all controls on individual development by Europeans are suspect.

Since South Africa left the Commonwealth in 1960, necessary economic and financial controls have been introduced and accepted in order to keep the country in a healthy economic condition. It may be that the acceptance of these controls will pave the way for greater acceptance of measures aimed at improved land use. The success of government economic controls has been undoubted. If the South African people could be convinced of the value of resource inventory and land planning for the greater benefit of all the nation, a major victory in development would be won. At the present time,[77] the South African government has introduced a Physical Planning and Utilization of Resources Bill in the House of Assembly, which will give wide powers to the Minister of Planning. It is aimed chiefly at the regulation of industry, but deals also with the utilization of resources and the determination of the use to which the land may be put. It is the government's intention that the

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77. See the Johannesburg *Star*, weekly edition, June 10, 1967.

Minister of Planning have authority to override the decisions of local and regional planning bodies. If the bill is passed, its chief purpose will be to strengthen the governmental policies of urban development and industrial decentralization, but it may in time affect all land use in the Republic, for good or ill.

CHAPTER V

A DISCUSSION OF COMPARABLE STUDIES DONE OUTSIDE SOUTHERN AFRICA

Major developments in land classification have occurred during the past half century. Scores of studies have appeared for most of the earth's inhabited areas, with a great variety of methods being used to achieve many different ends. Although formative work appeared prior to 1930, it was during the decade just before the Second World War that the sorry state of agriculture in many areas, and the new concept of planning for resource creation and rehabilitation which developed from the Dust Bowl crisis and the U.S.S.R. post-revolution planning approach prompted investigations to discover the causes of widespread difficulties. Among the most important investigations were the British Land Use Survey, the Sudan Land Use Map, Land Use in Ghana, the Puerto Rican Rural Land Classification Program, Rural Land Use In New Zealand, Canadian Use- Capability Studies and the Glackmeyer Land-Use Report, all of which will be discussed.

(i) The British Land Utilization Survey (1931)

In 1931, a team of pioneers in Great Britain instigated the Land Utilization Survey of Britain. The bulk of the field

work was completed by 1935. The British exercise was originally purely academic, and in this role it was accorded great recognition; in time its findings were also to be of great advantage to war-time Britain, and of utility to post-war planners in that country. Professor Dudley Stamp achieved fame as the Director of the Land Utilization Survey, and later served as adviser to other governments and bodies concerned with the mapping of land use in their territories. He also advised the International Geographical Union on the World Land Use Survey classification, which first appeared in print in 1950.[1] The influence of the British survey has been very widespread, with surveys frequently directed or carried out by British-trained geographers. Such work has been done in India, Hong Kong, Burma, Ghana, the Sudan, the Transvaal Lowveld, and the West Indies.[2] Many such studies remain at the descriptive level, while others emphasize

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[1] S. Van Valkenburg, "The World Land Use Survey, Economic Geography, Vol. 26, 1950, pp. 1-5.

[2] Examples of such work are: T. R. Tregear, A Survey of Land Use in Hong Kong and the New Territories, World Land Use Survey, Monograph 1, Hong Kong University Press, 1958. Maung Kyaw, "The Land Utilization of Insein District, Burma," Malayan Journal of Tropical Geography, Vol. II, March 1954, pp. 56-61. M. Cole, Land Use Studies in the Transvaal Lowveld, World Land Use Survey Occasional Paper, No. 1. J. H. G. Lebon, "Land Use Mapping in the Sudan," Economic Geography, Vol. 35, 1959. E. Paget, "Land Use and Settlement in Jamaica," in R. W. Steel and C. A. Fisher (eds), Geographical Essays on British Tropical Lands, Geo. Philip and Son, London, 1956.

physical background or cultural influences as these affect an area's land use. Causal relationships are often examined in explanatory memoirs accompanying maps of varying scale, detail, and completeness. Much of the work done on the British model or under the auspices of the World Land Use Survey has been used for planning, to improve unsatisfactory land use in existing agricultural areas, or to plan the development of newly-settled regions.

Great Britain has now had two national surveys of land use. Although the first survey was known as a land utilization survey, nowhere is there a distinction made between the terms use and utilization. In fact, the second survey, which was modelled on the first, is known as a land use survey. The land utilization survey had its start when Stamp recognized the possibilities of a highly detailed study of a nation's land. The survey had a dual purpose: to discover how the land was used, and to acquaint students with mapping procedures and with their environment. Since the United Kingdom possessed very detailed map coverage, the base maps were readily available, if sometimes out of date. The Ordnance Survey six-inch maps (a scale of 1:10,560) were first completed in the last decade of the nineteenth century, although periodic revisions had been made. These were the field maps used, but the final published maps were on a 1:63,360 scale. The simple yet comprehensive classification devised for the Land Utilization Survey was a major factor in the successful

execution of field-mapping by workers who were not highly trained. Below is the classification as it appeared in the surveyor's leaflet distributed at the time.[3]

	Letter	Colour
1. Forest and Woodland	F	Dark Green
2. Meadowland and permanent grass	M	Light Green
3. Arable or tilled land, fallow, rotation, grass, market gardens	A	Brown
4. Heathland, moorland, commons, rough hill pasture	H	Yellow
5. Gardens, allotments, orchards, nurseries, etc.	G	Purple
6. Land agriculturally unproductive, e.g., buildings, yards, cemeteries, mines, etc.	W	Red
7. Ponds, lakes, reservoirs, ditches, dykes, streams and anything containing water	P	Blue

The edges of adjoining map sheets provided some check on each surveyor's accuracy. Completed sheets to the one inch scale were reduced at survey headquarters, and the final map appeared in the seven distinctive colours of the key. A generalized national picture, at the scale of 1:625,000, also appeared in two sheets, and a variety of other maps such as a land classification map, showing land quality, and a types-of-farming map, were produced from survey and other relevant information.

Shortly after completion of the field work, enemy action

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[3]L. D. Stamp, The Land of Britain, Longmans, Green & Co., London, 1950, Chapter II.

during the Second World War destroyed printing plates, map stocks and other irreplaceable material. Fortunately some record of all the work existed, so that the portrait of the face of Britain in the 1930's could be completed. But many sheets became unobtainable and others were soon out of date. The time of the land utilization survey was a time of recession in British agriculture, so a scene very different from that of the war years was recorded. The picture in post-war years, too, was very different from that of the immediate prewar days. During the prewar agricultural slump, it was a fairly valid assumption that any land under cultivation was of good quality, since marginal land would have been the first to be abandoned. This observation stood Stamp and his co-workers in good stead when they assessed land quality for planning purposes.

The land utilization survey of Britain revealed in considerable detail a greatly varied use pattern. This type of survey is feasible only in a densely populated, small country. It was executed by an army of interested unpaid workers, entirely by field survey, without sophisticated techniques. At no time was aerial photography used, although it might have facilitated mapping, especially when base maps were seriously out of date. In such circumstances, surveyors merely sketched in features not shown on the base maps.

In South Africa air photographs of the Western Cape Province had been taken by 1938. These were used shortly

afterwards by W. J. Talbot for a land use and soil erosion survey,[4] so the techniques of analysis were widely understood and employed before World War II. Government agencies in the United States have used aerial photography extensively since 1930.[5]

Subsequent development of the British survey drew supplementary material from climatic records and from surveys of such factors as soils, vegetation and farming output. Once causal relationships were established, the framework of present land use could be used to determine types of farming, and to outline the broad pattern to be followed in planning for optimum land use. Thus the land utilization survey of Britain was not tailored to fit a planning objective, but it outgrew its beginnings to prove of considerable national value. Above all, its success depended on the foresight from which the project originated, the considerable organization required to complete it, and the enthusiastic response of an enlightened public. The combined advantages of a small, if diverse, territory, a highly educated population and complete map coverage on suitable scales are rarely found outside Europe, and are strikingly absent from Southern Africa. Nonetheless, much may be learnt from the British land utilization survey in terms of simplicity, coverage, organization and the application of results.

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[4] W. J. Talbot, Swartland and Sandveld, Oxford University Press, Cape Town, 1947.

[5] American Society of Photogrammetry, Manual of Photographic Interpretation, 1960, Ch. I, p. 7.

The land utilization survey was widely used for purposes of academic study in Britain, and it was in this way that its deficiencies became most apparent after twenty years had elapsed. The post-war boom in British agriculture changed the land of Britain considerably, and technical progress had affected land use by changing farming methods. Then, too, the wartime destruction of printing plates meant many sheets could not be reprinted. A modern geographical tool was in demand by academics, and the existing land utilization survey had become an "historical document."[6] Due in large part to the pioneer survey, there was a well-developed appreciation of the nature and value of land use maps. Quite a large body of trained geographers in the British Isles demonstrated enthusiasm for the idea of a second national land use survey when public co-operation was requested in January, 1960. In a single week, one-third of the land area of England and Wales had been undertaken for survey by volunteers who were required to furnish their own field maps and transportation.

The second land use survey differs appreciably from the first. One of the fundamental differences is in the classification used. It is designed to "permit the tracing of more accurate and sensitive correlations"[7] than the original seven category classification. It is meant to accord with the World Land Use Survey classification (Old

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[6]Alice Coleman and K. R. A. Maggs, Land Use Survey Handbook, Fourth (Scottish) Edition, 1964, p. 1.

[7]Ibid., p. 3.

World Division), although settlement is shown not in red but grey, the colour already used on the Ordnance Survey maps. The new British classification has been designed to be used at two different levels of intensity. The first and obvious level uses thirteen categories, each shown by a distinctive colour, while subdivisions of each group make up sixty-four categories at the second level of intensity; these sub-groups are indicated by variations of tone within the main colours, and by other muted cartographic devices. Moderate scrutiny of the maps, which are printed on a scale of 1:25,000, should reveal distinctions without interfering with the clarity of the thirteen main groups. These are:[8]

Category	Key Colour
1. Settlement, residential and commercial	Grey
2. Industry	Red
3. Transport	Orange
4. Derelict land	Black stipple
5. Open spaces	Lime green
6. Grass	Light green
7. Arable	Light brown
8. Market gardening	Purple
9. Orchards	Purple stripes
10. Woodland	Dark green
11. Heath, moorland, and rough land	Yellow
12. Water and marsh	Light Blue
13. Unvegetated land	White

[8]Alice Coleman, "The Second Land Use Survey: Progress and Prospects," Geographical Journal, Vol. 127, 1961, pp. 168-186.

A further difference between the first and second surveys is the use of a pilot survey to test the classification and methods to be used. A five hundred square mile tract in East Kent was selected for the 1960 pilot study, since every category of British land use and every crop grown in Britain were to be found there. Modifications to the classification were made during and after testing here and elsewhere. The services of schoolchildren have not been used for the second land use survey as for the first, partly because there were more geographically trained volunteers available and partly because of the more sophisticated classification. As in the first survey, the maps of the second are being accompanied by reports which are of three kinds:

(a) Progress reports, written by field workers during survey.

(b) Sheet reports, written by the leader of the survey team (or a single surveyor) upon completion of one six-inch map sheet.

(c) County reports, to be produced by experienced geographers once an entire county has been surveyed.

It may be noted that both British land use surveys are academic rather than practical, in orientation. In the surveyor's handbook the Director of the Second Land Use Survey stresses that "much of the value of a land use survey depends on the simultaneity of mapping to give a synoptic picture of the whole country."[9] Nevertheless, during the period 1960-1964

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[9]Coleman and Maggs, op. cit., p. 4.

the mapping of England and Wales was only sixty percent completed, so a considerable time lag existed in the surveying. Surveyors were urged to map in solid blocks, so that areal ratios would not be distorted by gaps being filled in the following year when crops might have been rotated. It seems curious that the use of aerial photography was not considered since it is an ideal way to achieve the desired simultaneity of mapping. An up-to-date land use survey which makes no use at all of aerial photography is unusual.

(ii) <u>Land Use Mapping in Sudan (1959)</u>

One of the major undertakings inspired by the World Land Use Survey scheme was that of J. H. G. Lebon on Sudanese land use.[10] In several respects, the Sudan presents land classification problems analogous to those of Southern Africa. The Sudan is, as Lebon says, "typically African."[10] By this is meant plateau formation, with isolated high points appearing on the tableland, and the presence of broad vegetation zones, which range from equatorial rain forest through savanna to desert. As in Southern Africa rainfall is the chief factor which controls natural vegetation and often controls land use. Although aspects of Southern Africa's land use differ from the situation in the Sudan, the following statement would hold true for both areas: "Used unimproved

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[10] J. H. G. Lebon, "Land Use Mapping in Sudan," <u>Economic Geography</u>, Vol. 35, 1959, p. 62.

grazing land (6a) is the most extensive of all land use categories."[11] Further similarities may be shown for the effects of tsetse fly infestation, and the marked influence of irrigation on land use.

Because of the practical problems of classifying the land of an extensive African territory with incomplete map and aerial photographic coverage, the techniques developed by Lebon should be of value in Southern Africa. Mapping the land use of the Sudan presented well-nigh insurmountable difficulties, since no previous land use maps existed for the country. The topographic map series at 1:250,000 was the largest one with national coverage and much of it was the result of reconnaissance survey only.[12] Lebon's familiarity with Sudenese patterns of settlement made a starting point possible. Virtually all settlements were marked on the maps which had been prepared for, and by administrators. Because almost all cultivation occurs within five to seven miles of such settlements, cultivated areas could be shown on a small scale map by the simple expedient of enclosing all areas within this distance of settlements.[13] Where aerial photographs had not been taken, chiefly in the north and south-west, mapping on the 1:250,000 scale, using additional information from such

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[11]Lebon, <u>op. cit</u>., p. 68.

[12]<u>Ibid</u>., p. 60.

[13]<u>Ibid</u>., p. 61.

specialized maps as those of soils and tsetse fly infestation, was the procedure followed. However, in the central Sudan, United States military air photographs and more recent Sudanese government coverage are available, and these photographs were used to complete a set of land use maps on the World Land Use Survey's standard scale of 1:1,000,000. Land use types have been tabulated by area, a single-sheet reduction has been published, and a memoir analyzing and interpreting the results has been written.[14]

The classification used in the Sudan study is both an expansion and a modification of the inventory of World Land Use. Five of the nine principal use types have been included. These are: 4 (Cropland), 6 (Grazing Land), 7 (Forest), 8 (Marsh), and 9 (Unproductive). Category 4 has been divided into two sub-classifications, as has category 6, while category 7, in the Sudanese classification, has four subdivisions, making ten major categories in all. Horticulture and tree crops occur over so small an area that they could not be shown on the 1:1,000,000 scale.[15]

Perhaps the most important contribution of the Sudanese survey to the field of land use survey is its demonstration of how much can be achieved despite considerable obstacles.

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[14]J. H. G. Lebon, The Land Use Survey of Sudan: Some Problems of Classification and Mapping, in UNESCO, Land Use in Semi-Arid Mediterranean Climates, Paris, 1964, p. 139.

[15]Ibid., p. 143.

The major obstacles were the lack of funds and field staff, poor map coverage and poor surface communications. Rather than the usual map of "types of land use" which results from generalized studies of this kind, Lebon produced a complex map of actual land use, insofar as the World Land Use Survey Classification allows this. He pointed out, quite correctly, that this classification is in effect a combination of actual land use, types of agriculture and some vegetation types, but that this does not nullify its value at all.[16] This study was largely the work of one man, who covered a large area in considerable detail with little field work. It is essentially a preliminary study, which revealed a great deal previously unknown about this section of Africa, and about the problems of land classification there. It is fitting to quote Lebon on his hopes for his work:

> It is my belief and hope that the results of this work will contribute towards the understanding and solution of the increasingly serious land use problems of the country, and be an example of the help university geographers can give to the new countries of Africa.[17]

As an academic exercise, it may not yet have given rise to specific agricultural development projects or irrigation schemes, but it should familiarize Sudanese administrators with what exists in their country and alert them to development possibilities and procedures.

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[16] Lebon, op. cit., Discussion, p. 148.

[17] Loc. cit.

(iii) Land Use in Ghana (1962)

A major work has emerged from an independent African nation, one which is keenly aware of the importance of its land. Agriculture and land use in Ghana have been studied by a team of experts, whose investigations and findings appeared in a recent volume.[18] The work is published in two parts, the first being concerned with those environmental conditions which have a direct bearing on agriculture, while the second part treats particular aspects and problems of land use in Ghana. Since this work is a compendium of information on a wide range of subjects, it has been produced by a team of experts, each very knowledgeable about his subject and familiar with Ghana. Thus, weather and climate are discussed by a former Director of Meteorological Services, and specific plant diseases by government botanists. The work was directed from the start by men concerned with correct land use, who had studied the field both in Ghana and abroad. There is a mine of information in this book, much of it devoted to the discussion and treatment of specific problems, and a great deal applicable to the difficulties of the individual agriculturist. Despite the fact that a chapter on the general planning of land use is included, there was no detailed survey of actual use, conducted either on the ground or from the air. Aerial photographs were used chiefly to

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[18]J. Brian Wills (ed.), Agriculture and Land Use in Ghana, Oxford University Press, London, 1962.

determine types of settlement and methods of making a living from the soil.

The general pattern of land use is discussed in terms of the broad zones delimited, their characteristics and the causal links between the people, their environment and their way of life. Essentially, the five selected land use zones are allied to major vegetation formations, which in turn are closely tied to rainfall regimes. Ghana experiences both double-maximum and single-maximum rainfall regimes through the migration of the Intertropical Convergence Zone; the resulting regimes affect vegetation and land use greatly. Since a seasonal deficit of moisture has a strongly limiting influence on plant growth in the tropics of Africa, where all other climatic elements are adequate, the transition from a double maximum to a single maximum of precipitation reflects the transition from a long to a short growing period. The simple zonation of natural vegetation in tropical Africa is, of course, affected by man's actions, especially by grass-burning or clearing soil for cultivation.

The influence of such geographic factors as climate, soils and relief is discussed as they affect the distribution of land use zones. The process of commercialization of the subsistence economy is discussed in terms of the actual occurrence and its effect upon community and the nation. Wills refers to G. V. Jacks' discussion of the evolution of man's care of the soil. Shifting cultivation, as the first

stage, retains an ecological balance between the natural vegetation and its environment, thus a small population group in a large area does not endanger the fertility of the land.[19] The second stage is usually soil exhaustion, as a rising uninformed population in permanent settlements tills the soil without replacing plant nutrients or combating erosion. In simple rotations, even the fallow period is shortened until natural vegetation no longer occurs, and no natural organic material nor chemical fertilizer is added. The final stage, as Jacks envisages it, comes when man returns more to the soil than he removes from it, since he has become a wealthy urban dweller, aware of the importance of enriching the soil. This is no more than an ideal for most of the present world, but by education and example it may be obtained in some locations. Most of Ghana is considered by Wills to fall into the first stage, while the second stage has been reached in places. Although land rotation is more common than shifting cultivation,[20] soil exhaustion is not yet characteristic of most of Ghana. One of the aims of the study of the land use of Ghana is to limit this second stage to decades rather than centuries, since it cannot be entirely avoided. To evaluate Southern Africa in Jacks' terms, stage one of shifting

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[19] G. V. Jacks, The Influence of Man on Soil Fertility, Adv. Sc., Vol. 13, 1956, pp. 137-143.

[20] Wills distinguishes between land rotation and shifting cultivation. Land rotation is a system whereby a period of cultivation is followed by a period of rest for the land, before the land is recultivated. Settlements are fixed and the same land is used over and over. In true shifting cultivation settlements are not fixed, and the inhabitants may move considerable distances.

cultivation would be rare today, stage two would be prevalent, and stage three inexcusably absent, with but few exceptions.

The map of land use which accompanies Wills' text is reproduced on a very small scale, so simplification of the original map was necessary. Nonetheless, this remains a map of types of farming rather than actual land use, although some of the categories mapped are purely vegetation types, e.g., coastal thicket and grass savanna. What are described are essentially patterns of utilization, characteristic assemblages of elements in the agriculture of a zone. For example, category 7 (derived savanna zone) is described thus: "Less intensive land rotation with tree savanna regrowth fallow and some small cultivated forest outliers."[21]

Each broad land use zone is discussed in terms of its geographical environment, the settlement types with their associated pattern of cultivation, the crops found there, and the type of animal husbandry practised. The limits of each zone are indicated, and particular characteristics are noted, while the differences between zones are also discussed. In this treatment, causal relationships are traced wherever possible, and aerial photographs are used to illustrate the points made. In all, this is an excellent and illuminating discussion of Ghanaian agricultural geography, although the inventory of the country's land resources is not presented in such a way as to provide a basis for planning. The

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[21]Wills, <u>op. cit.</u>, p. 203.

volume devoted to agriculture and land use probably contains much factual information which could be used for a comprehensive land use plan of Ghana in the future.

(iv) The Rural Land Classification Program of Puerto Rico (1952)

An excellent example of a comprehensive land use study is the Rural Land Classification Program of Puerto Rico.[22] This study was motivated by

> the high population density of Puerto Rico characterized by acute pressure to gain a livelihood, the physical characteristics of the island, the use being made and the potentialities of its resources, and the intricate interrelated problems involving these manifold conditions.[23]

The critical problems faced by Puerto Rico concerned the question of making more effective use of land resources. In order to achieve this goal, it was essential to know precisely what the natural, economic and social conditions were. So the chief aim of the project was to obtain "with a minimum of cost a large scale accurate inventory of the land uses and of the physical characteristics of the land throughout the island."[24] The inventory was not expected to provide cures for all of Puerto Rico's ills, but to furnish essential data to be used in setting up development plans to solve some of the island's problems. Once the objectives of

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[22] The Rural Land Classification Program of Puerto Rico, Northwestern University Studies in Geography, No. 1, Evanston, Illinois, July, 1952.

[23] Ibid., p. 1 (Clarence J. Jones).

[24] Ibid., p. 27.

the programme were formulated, careful plans were laid by experienced administrators and geographers, and the decision to map by fractional code notation was taken. A pilot study was set up, using a north to south cross-sectional traverse through the centre of the island, plus fifteen selected areas, in order to cover all island conditions comprehensively. The procedures used were rigorously tested so that all the important aspects of the physical background and the environment should be included and the data mapped by the different field teams should be comparable. Mapping procedures, land use and land characteristic keys were carefully tested and scrutinized, while all terms were accurately defined. Only when the pilot study and its results satisfied the survey's directors, was the national programme begun.

Puerto Rico was in a very fortunate position for its national resource inventory, since the territory of 3,421 square miles is small enough to be covered by a small group of field men. Some funds were provided by the national government, which viewed this as a priority project, but the United States also provided financial assistance. Most important of all, graduate geography students from ten United States universities became the field workers. This was an admirable arrangement from every viewpoint, because the students worked for little remuneration, were skilled in field techniques, and were deeply interested in the project which was supplying research material for them. Uniformity

of mapping was excellent, due to the fact that every worker was trained in the field by an experienced man. Local assistance was given by a Puerto Rican interviewer attached to every two-man survey team; his primary purpose was to obtain field data which could not be mapped.

The entire island was mapped at a scale of 1:10,000, all field work being recorded on aerial photographs at that scale. Margin distortion on the photographs proved to be no bar to accurate plotting, although it created difficulties in later map-making. Careful preparation before venturing into the field made for a minimum of wasted time and a high degree of accuracy. Key features were marked on the photograph beforehand, then the field worker recognized and marked on the photograph "the limits of a unit area which is characterized by a complex of features, each of which approximates homogeneity throughout the unit area."[25] The fractional code showed land use as the numerator and the physical characteristics of the land as the denominator. It was set up thus:

$$\frac{\text{major category of land use, major class of land use, quality of use}}{\text{soil mapping unit, class of slope, drainage, rate of erosion, stoniness and rock exposure}}$$

and might typically appear on a unit area of a photograph as

$$\frac{112}{52\text{-}1121}$$.[26]

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[25]The Rural Land Classification, op. cit., p. 12.

[26]Loc. cit.

It would be tedious and of little benefit to list the key to each component of the fraction. However, certain categories and classes of land might be noted briefly. There were three categories of land use:

(1) Land used for primary production (crops, pastures, forest production).

(2) Land used by man, but not for primary production (e.g. houses).

(3) Land not being actually used.

The second figure of the numerator referred to classes of land use, of which there were eight:

1. Cropped land.
2. Pasture and harvested forage land.
3. Forest and brush land.
4. Non-productive land.
5. Rural public and community service land.
6. Quarrying and mining land.
7. Urban and manufacturing land.
8. Miscellaneous uses.

The denominator of the fraction covered those land characteristics which might be observed and which were considered to be significant in consideration of the use of land. Each physical characteristic, with the exception of soil, was divided into classes numbered in the order of their value for agricultural use, with class one being the most desirable. The soil classes were taken from the fifty-three soil mapping

units developed by the United States Soil Conservation Service of Puerto Rico, because they corresponded to topographic variations and differences in climate and parent material.

The field work for the Puerto Rican project was completed in two years, although it was expected to take more than four. The data obtained were used to produce land use maps and the information was tabulated for governmental planning purposes. The students involved drew on the results for dissertations. The land use pattern was simplified in order to produce a 1:10,000 set of maps; crop and pasture quality were omitted, while certain classes of cropped, pasture and forest land were combined to make twenty classes, instead of the original fifty-nine. Letter symbols were used instead of shading, both for economy and to achieve transparency, since overlays such as rainfall maps were employed effectively. Small-scale maps to show broad land use patterns were also produced.

This rural land classification programme bore early fruit in the handling of specific problem areas and the formulation of overall planning policy. A specific study of the Coamo-Bauta power, irrigation and water supply project involved special mapping of twenty-five square miles. Data concerning the physical conditions, present use and probable use if irrigated, were then analyzed by the Puerto Rican Scientific Land Use Division. The verdict was that the

large expenditure necessary for the development of the project was not then justified in view of other priorities. This is an instance of land classification contributing directly to the best use of an area's resources, having advanced far beyond an academic exercise. On a broader scale, the land classification maps for the entire island showed the terrain, crops and farms to road planners, while the aerial photographs provided a basis for evaluating increased agricultural production by comparing similar land types which were not equally well-served by roads. Analysis of such information did indicate the economic justification for the construction of new roads. Maps of recommended land use, at the same scale as the land use maps, were prepared from survey findings, including such factors as the advisability of increasing locally-grown foodstuffs, the need for industrial development and the necessity of protecting catchment areas. Recommended land use for each specific type of land was indicated. The chief aim of this exercise was to increase production, thereby raising the people's standard of living, while also conserving the island's natural resources of land, water and forests.

The Rural Land Classification Program of Puerto Rico was designed to be an initial study in the continuing land use planning programmes of several government agencies. It was the essential first step of an "inventory and analysis of basic data, to be used in the effective formulation and

effectuation of governmental programmes."[27] It was highly successful in amassing relevant data and interpreting them in locating special problem areas, and revealing the interrelationships between social and economic problems and the environment. Far removed as the tropical island may be from Southern Africa in most respects, there are common problems to be faced. The basic need is for an inventory of resources, in sufficient detail to satisfy planning requirements, with such an inventory becoming a preliminary step in a continuing programme. Areas of Southern Africa are also overpopulated, so that there is consequent difficulty in making a livelihood. Then, too, the contrast between subsistence and highly successful commercial agriculture exists as in Puerto Rico. In Southern Africa, the demand for irrigation, the drawback of great expense, and the limited life of dams, suggest that the need for improved catchment area conservation is comparable. But it is in the field of aims, organization and efficiency of effort that the Puerto Rican survey has most to offer as an example to much of the world. It is also a rare example of a survey having immediate practical application.

(v) Rural Land Use in New Zealand (1956)

The classification of rural land use in New Zealand, which was presented by James W. Fox, has not been tested in a national survey, but the author drew both on his wide general

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[27]The Rural Land Classification, op. cit., p. 27.

knowledge of land classification, and on his practical experience of studying land use problems in the northern King Country of New Zealand.[28] The purpose of Fox's work was the encouragement of a nation's stock-taking of resources, basic to which would be an objective national land use survey.[29] "New Zealand's basic resource is her land, and a primary concern must be its effective use and utilization. Not only must new land be brought into production, but land already cultivated must be more intensively farmed."[30] In order that a national land use survey could be completed, Fox developed a fairly simple and very logical classification, which could be mapped by laymen, if suitable base maps were available. Both the 1:25,000 and 1:63,360 series of topographic maps for the islands were incomplete, and available smaller scales are unsuitable for this purpose. Possibly semicontrolled aerial mosaics, at approximately four inches to the mile, might have helped to fill the gap, since most of New Zealand is covered by high quality aerial photographs.

Fox's classification attempted to remedy what he regarded as some of the deficiencies of the World Land Use Survey. As he rightly pointed out, on the 1:1,000,000 scale the minimum area represented would be four square miles; few

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[28] James W. Fox, Land Use Survey. General Principles and a New Zealand Example, Auckland University College, Bulletin No. 49, Geography Series No. 1, 1956, Footnote 70, p. 33.

[29] Ibid., p. 40.

[30] Loc. cit.

areas possess uninterrupted stretches of one type of land use of this magnitude. Fox also considered the World Land Use Classification arbitrary, in that different criteria were used to define classes having equal rank in the classification , resulting in the broad term "cropland" being rated equally with "tree and other perennial ~~unproductive~~ crops." He found also that the classification could not be used effectively on the small scale of maps chosen for it.[31] Furthermore, the usefulness of land use maps on the scale of 1:1,000,000 would be questionable. Fox believed that more surveys on a national scale were imperative before a general world scheme could be developed, since the solution of particular problems would guide the formulation of general principles.[32] Consequently he tailored his New Zealand classification to prevailing conditions in that country.

The New Zealand classification divided rural land use into four major categories: ordinal, generic, specific, and varietal. The ordinal classes were:

I. Cropland

II. Pasture grassland

III. Woodland and hedgerow

IV. Forest and scrub

V. Virgin grassland

VI. Unproductive land

Classes I, II, and III were agricultural land, classes IV, V

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[31] Fox, op. cit., p. 30.

[32] Loc. cit.

and VI were non-agricultural land. As an illustration of the progression of categories, cropland was divided into intensively cultivated and less intensively cultivated land, at the generic level. At the specific level, intensively cultivated land gave way to intensive cropland--garden and special cropland--and orchard and tree cropland, while the varietal category listed such detail as citrus fruits or grains. In the pasture grassland category, quality of ground cover and nature of weed infestation were recorded as part of the specific category. Map colours, plus hatching and stippling were used to differentiate classes.

While this classification is in every way concerned with present use, it is comprehensive enough to include such factors as type of crop grown, whether trees are exotic or indigenous and the condition of ground cover. It is admirably suited to a predominantly pastoral area, although it may take more than a layman to distinguish between "rough range grassland" and "depleted grassland." Fox contended that this land use survey has "particular usefulness in areas of marginal land or pioneer farming."[33] Its full interpretation, when supported by information on related factors, such as soils, climate and the historical background, may indicate possible future development. It is practical, rather than academic, in orientation. Certainly periodic "stocktakings" of this kind show the changes in the landscape, and these may be studied

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[33] Fox, op. cit., pp. 38-9.

in order to indicate the reasons for them and prospects for the future.

Fox's classification, with certain modifications, has already been applied to a small area of Southern Africa, and has proved entirely workable in the field survey.[34] It proved sufficiently comprehensive to record the varied land use of an area less than twenty miles from Southern Africa's largest urban centre, Johannesburg. It is also suitable for the excellent 1:18,000 topographical sheets produced by the South African Trigometrical Survey, which are unfortunately not available for most of the Republic. The New Zealand classification, due to the application of painstaking logic, avoids that overlapping of categories common to some other classifications, which can only reduce objectivity by raising doubts. Furthermore, it is designed for a pastoral country of generally sparse and recent settlement by Europeans, a situation not unlike Southern Africa in some respects. An adaptation of Fox's work might well be a suitable classification for a general Southern African survey of present use.

(v) Use-Capability Studies: Canada

Since land classification is by no means restricted to present use studies, it is as well to consider some studies concerned with other aspects of the field. Two use-capability

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[34]M. Breckenridge, Land Use in the Jackson's Drift-Van Wyk's Rust Area, unpublished thesis, University of the Witwatersrand, Johannesburg, 1960.

studies done for parts of Western Canada will be discussed briefly.[35] These studies bear some resemblance to existing agro-economic surveys of Southern Africa in terms of the type of data collected, investigations made, and the overall economic emphasis of the work. There are, however, two major differences between the African and the Canadian studies: first, these Canadian studies were concerned not with a national situation, but with particular areas and specific problems. The major problem was to identify land which was marginal for wheat production under prevailing conditions, and which subsequently exhibited instability of settlement and the attendant social ills. The second difference between the national agro-economic surveys and the local economic land classifications lay in the manner of assessing use-capability. In Canada the assessment was in terms of wheat production measured quantitatively, i.e., in terms of the amount of wheat produced per unit area. In other words, recommendations for the future of the area were made by relying solely on the criterion of wheat cultivation, once data about the physical environment, economic situation and history of the settlement were evaluated. Recommended use was

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[35](a) A. Stewart and W. D. Porter, Land Use Classification in the Special Areas of Alberta and in Rosenheim and the Acadia Valley, Canadian Department of Agriculture, Publication No. 731, Technical Bulletin No. 39, February, 1942.
(b) C. C. Spence and E. C. Hope, An Economic Classification of Land in Fifty-six Municipal Divisions, South Central Saskatchewan, Canadian Department of Agriculture, Publication No. 728, Technical Bulletin No. 36.

a facet of the Southern Rhodesian agricultural survey, but it was not confined to a single criterion, nor to one use of the soil. It was a judgment based on a consideration of the physical characteristics of the area and the type of farming practised; because there are more variables, it may be less objective than a quantitative use-capability classification, but it offers more scope to the land-user.

In the second study, Spence and Hope established five classes of land, while Stewart and Porter had established four. In both instances the pivotal point of the classification was the determination of what is marginal land for wheat production. Marginal land was the second class considered in both cases, and was understood to be land which, without payment for its use, might be expected to provide a return to the farmer merely sufficient to induce continuity of production.[36] All land producing less than marginal land was considered unsuitable for wheat-growing under the prevailing conditions of a farm of typical size (a quarter-section or 160 acres), worked by prevailing farm practices. Those classes of land which produced more than the marginal amount were considered suitable for wheat farming, but in varying degrees. A good deal of reliance was placed on past farming experience in the area during the limited period of settlement. Both studies collected all available information on farm

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[36]Stewart and Porter, <u>op. cit</u>., p. 13.

management, history of occupancy and on such physical factors as soils. Soils were especially important because they showed local variations while other factors remained constant. The findings revealed that soil changes not apparent to the inexperienced settler could influence the success of farming and permanency of settlement greatly. Use-capability classification provides a guide to the potential of newly settled or pioneer areas, so it can contribute much to the realization of optimum land use. Use-capability classification, with assessment in terms of a single crop, has its greatest value where a staple crop is likely to retain its importance in the foreseeable future. In areas not dominated by a single crop, this type of assessment has only limited value. In much of Southern Africa, domination by the single crop of corn or maize exists at present, and is likely to continue. Use-capability classification would be valid, and most helpful, in such areas, provided maize was the best crop for the area.

(vii) The Glackmeyer Land Use Report (1960)

Areas which could be opened to planned settlement might offer an outlet for population pressure elsewhere. Such areas are not necessarily virgin land; past attempts at settlement may have been unsuccessful because the land was poorly used, or existing settlements may not be realizing the area's full potential. A development plan should show the way to realization of full use potential, after a complete resource

evaluation. The Glackmeyer municipality of Northern Ontario was the site of a study which culminated in a development plan for one hundred years.[37] (This lengthy period was chosen because a full forest rotation takes a hundred years, and forest use is and probably will continue to be dominant in this area.) The objective of the Glackmeyer study was:

> To conduct land-use research on a demonstrated area in order to obtain data which illuminate the principles and practices of good farm, forest and wildlife management in the Cochrane Clay Belt and thus provide a basis for the formulation of land-use policies.[38]

The area was thus being studied as a typical segment of a large area having similar attributes and problems. The Ontario Department of Lands and Forests was fostering optimum use of the area through studying its characteristics and the implementation of policy guide-lines for future use in the area. It may be pointed out that four separate development plans were drawn up, for agriculture, recreation, forest and wildlife management, but the separate plans were integrated. Agricultural use had some priority as food-producing lands were to be located in areas of the highest potential,[39] particularly because agriculture had to be on a commercial, not subsistence basis.

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[37] Ontario Department of Lands and Forests, A Multiple Land Use Plan for the Glackmeyer Development Area, 1960.

[38] Ibid., p. 1.

[39] Ibid., p. 9.

Since the Glackmeyer investigation was government sponsored, it was concerned with legislation governing land use, at present and in the future. The land use patterns of the area were assessed to determine the adequacy of present legislation. Recommendations were made for changes necessary to the establishment of a multiple land use plan, well adjusted to the land's natural qualities, and allowing agricultural development to meet future needs.[40] This multiple land use plan has three phases: development from 1960 to 1980, development from 1980 to 2000, and development from 2000 to 2060.

The methods of the Glackmeyer study are especially interesting, since they combine detailed field work with the use of aerial photographs. Aerial photographs alone provide a general picture of present use, and also provide the data for broad recommendations about future use. However, in the Glackmeyer study, local reference areas were set up, and a detailed study of the "interrelationships of the total complex of factors which bear upon the problem of proper land use"[41] was made. Land types were established as the basic units. Distinctive patterns of physiographic sites having characteristic local climates, soil moisture supplies, biotic types and soil types combined to produce land types.[42] Landtype mapping then sought these significant interrelationships outside the reference areas, using aerial photographs. This detailed

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[40]A Multiple Land Use Plan, op. cit., p. 40.

[41]Ibid., pp. 41-2.

[42]Ibid., p. 43.

field knowledge and ecological study could be applied over a wide area. This method was preferred to the independent study of single characteristics (soil, relief, climate), where complexes of interrelated features are not recognized,[43] and a given area may have a number of different ratings for single features. The chosen approach attempts to evaluate "the effectivity of the total complex."[44]

The Glackmeyer report sought to provide a model land use study to serve as an example. It also served as a pilot study in depth, from which findings could be applied to a wider area. Its emphasis on stage by stage implementation of its integrated plans is unusual in a rural land use study, possibly because such a schedule has to come from an official source to have the slightest hope of implementation.

Two facets of the study would have application to the Southern African situation. The approach, which depends on detailed study to discover landtypes before lending itself to broad application by later use of aerial photographs, is well worth considering. It could eliminate endless detailed field work, as well as inaccuracies possible through complete reliance upon photographs. The second benefit from this report could be its hopeful attitude to the rehabilitation of badly used areas, where environmental hazards such as harsh climate, have impeded settlement. In Southern Africa fluctuating

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[43] A Multiple Land Use Plan, <u>op. cit</u>. p. 43.

[44] <u>Loc. cit</u>.

precipitation amounts have made vast areas highly susceptible to drought, and much drought-stricken land is abandoned in poor years. Well-planned schemes of resource evaluation, which include study of all the pertinent factors, may provide the key to better adjusted use and stable settlement.

CHAPTER VI

CONCLUSION

There is no doubt that Southern Africa's land resource potential is not being fully realized at present. There is also no doubt that realization of full potential today demands much more than the process of trial and error. For the greatest benefit to all the inhabitants of Southern Africa, optimum land use--the most productive and harmonious use of the soil--is essential. In order to achieve optimum land use, thorough investigation, full resource assessment, objective judgment and the implementation of planning decisions are necessary. The best use for a tract of land should be decided in terms of that area's special circumstances, within the context of the country's overall needs. Nevertheless, the land user must never be regarded as a pawn for the planner. Habit and ignorance must give way to scientific assessment and enlightenment.

As the preceding chapters have shown, land classification is not foreign to Southern Africa. There have been several major land classifications and a host of minor attempts. There has been a lack of co-ordination between surveys. Furthermore, little effective planning has stemmed from their findings.

Only one of the countries of Southern Africa, Zambia, appears to see its future with the independent African states to the north. The others, South Africa, Rhodesia, Lesotho, Botswana and Swaziland, have many traditional ties, and seem to be moving towards closer economic co-operation. All might be willing to co-operate in a far-reaching land classification programme. The advantages of international co-operation in such a project would be:

(a) the general availability of top personnel and facilities;

(b) the use of the best equipment and techniques available in the area;

(c) the benefits of experience gained in working under similar conditions, (e.g., the considerable advantages to be derived from the experience of the participants in the Southern Rhodesian agricultural survey and the Swaziland sample survey;)

(d) a greater availability of trained workers than would be possible for individual territories;

(e) the recognition of development possibilities which might benefit more than one territory, (e.g., Lesotho's water resources might be used to the advantage of both South Africa and Lesotho).

The approach to such an ambitious land classification project is important. Because of the conflict of national interests, an independent advisory body or council, composed of territorial representatives conversant with land

classification within the Southern African environment, might be set up. Government financial support and other assistance would be vital to a programme of this kind, but the independence and impartiality of such an investigation should be maintained. Since several of the Southern African universities have undertaken land use work, their experience, staff and facilities might be useful to such a body. University students, both graduate and undergraduate, would be excellent recruits for the process of classification, particularly if they could be trained to the high level of efficiency and objectivity achieved by the Puerto Rican survey workers.

Uniform resource assessment of all of Southern Africa would be feasible, given international co-operation in matters of facilities and personnel and the guidance of an independent directorate or advisory body. However, formation of a single plan of sub-continental dimensions would pose many problems, relating mostly to national politics. Since South Africa, Rhodesia, Zambia, Botswana, Lesotho, and Swaziland are all independent states, their policies will be based primarily on their national aspirations and not on broad international ideals. Thus it is unlikely that one land use plan could be drawn up for the whole of Southern Africa--nor could a system of priorities in the implementation of recommendations be established, since this would demand the abandonment of national aims in favour of international

ones. The states of this area, despite many close ties, differ in their political climates. The way in which national aims and aspirations affect planning is of great importance, so a review of the prevailing political climates of the states is necessary.

I. The Republic of South Africa

The most powerful state in Southern Africa is the Republic of South Africa. Although coastal settlement by Europeans occurred in the seventeenth century, most of the country was settled by pioneers (Voortrekkers) in the first half of the nineteenth century. As the latter moved north from the Cape they encountered Bantu tribes moving south, with results which were similar to almost all meetings between primitive and more advanced peoples. Religious, cultural, economic, and language differences left little room for communication between the races, except through warfare or the most rudimentary commercial transactions. "Separateness" was thus natural to a considerable extent, and, being fostered as well by the Europeans' feelings of superiority, it became customary. Custom in turn crystallized into tradition, and long before the Union achieved independence in 1910 the separation of the ethnic groups was one of the principal commandments of South African life. Therefore, when the present governing party, the Nationalists, came to power in 1948 and instituted a policy of 'apartheid' or separateness, they merely refined and extended the traditional

way of life and enshrined it within a political philosophy. The years since have seen systematic legislation to ensure segregation at all levels of South African society.

The core of the apartheid idea, however, is the development of what have come to be called "Bantustans"--semi-independent tribal homelands within the South African nation for the various Bantu peoples. Within these the individual will have full political rights and will be a full member of society, but if he chooses to remain in the European areas (as economists think a great many will be forced by economic necessity to do), he will suffer from the same political and social disabilities as at present. Among these are disenfranchisement, enforced separation of families due to the migratory labour system and no rights of land ownership in areas reserved for Europeans. There are presently one hundred and eight widely dispersed Bantu areas from which the government plans to produce eight Bantustans. One, indeed, has already gained internal independence,[1] and some of the remaining seven are beginning to take on some of the characteristics of political units. Development would undoubtedly be faster were it not for the financial difficulties involved. A successful Bantustan programme would require astronomical expenditure, and not even a fraction of the Tomlinson Commission's original estimate of £104,486,000,000

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[1]The Transkei, in 1963.

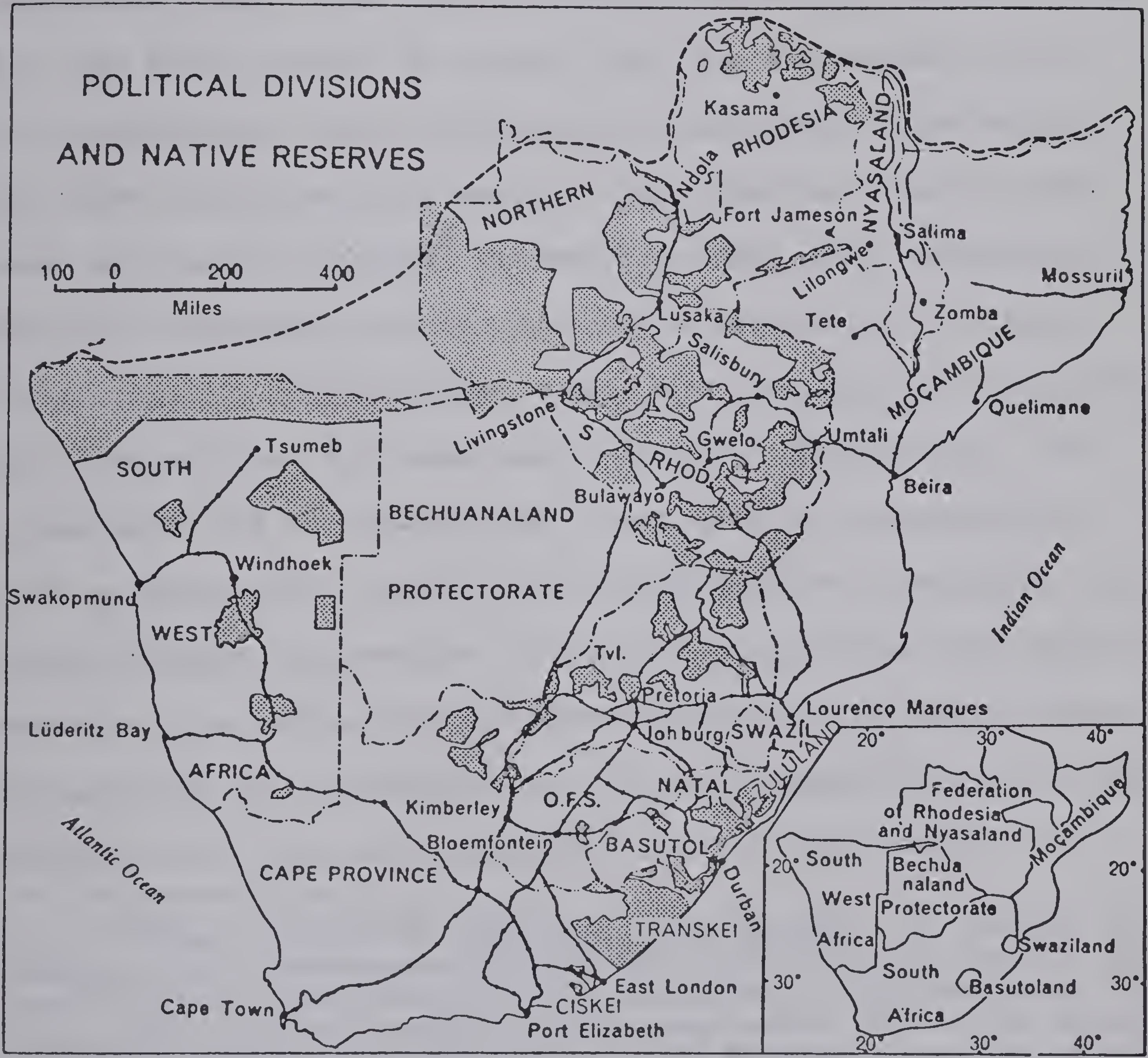

Fig. 14. Shaded areas are those reserved for Bantu.

From: L. P. Green and T. J. D. Fair, Development in Africa, Witwatersrand University Press, 1962, p. 78.

or approximately $315,000,000,000 has been spent to date.[2]

"Effective socio-economic planning" was the phrase used by the Tomlinson Report to describe the objective which should be striven for, and that phrase has been current in South Africa ever since the government officially endorsed the Bantustan idea. The report recommended such planning only for the Bantu areas, of course, not for the whole country. Two assumptions about "effective socio-economic planning" are made throughout the report: (a) that all Bantu areas must be planned in order to realize their full potential; and (b) that such planning should be based on a thorough understanding of the areas' resources, population distribution and composition, and land use problems. Nonetheless, the government did not accept the Commission's recommendation that a Development Council be established "to undertake continuous research into the potentialities, trends and requirements of the socio-economic development of the Bantu areas; to co-ordinate the investigations by state departments and other bodies; and to prepare plans for further development."[3]

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[2]Hobart Houghton, The Tomlinson Report: A Summary of the Findings and Recommendations of the Tomlinson Commission Report, South African Institute of Race Relations, Johannesburg, 1956, p. 1. The mammoth report of the Commission ran to 18 volumes and 3,755 pages. It was filled with factual information as well as development proposals, and is probably the largest single piece of planning work ever executed in South Africa. Its contents included historical and sociological material, a geographical survey of the Bantu areas, farming possibilities, development proposals for those agricultural regions delimited in the report, and special investigations into aspects of agriculture like irrigation farming, sugar-cane growing, fibre production, and forestry.

[3]*Ibid.*, p. 54.

All planning functions for the Bantu remain still under the jurisdiction of the Department of Bantu Affairs.

The Tomlinson Commission points directly to the political realities which the planner must take into account in South Africa. Of paramount importance under the apartheid system is the policy of separate development and it forms a major obstacle to the attainment of optimum land use. If there were a choice between the achievement of optimum land use and the achievement of official racial policy, the former would be considered far less important. Indeed, probably no national plan for optimum use is possible given the government's racial policy, for a national plan implies treating the whole country as a single unit, and this is exactly what apartheid forbids.

Despite this very considerable handicap some progress toward improved land use could be made as the result of national assessment, even if the achievement of true optimum land use for the whole country has to remain an ideal. Given the present political situation in the Republic, it must be assumed that no change of government or major alteration of policy is foreseeable. Consequently the planner would have to take cognisance of those artifical ethnic boundaries which cover the map of the country. Given a national resource assessment, however, planning recommendations which are consistent with, and even assist the development of Bantustans, should be easier than without it. Indeed, if the state is to

be divided into smaller political units, and especially if attempts are to be made to make each viable economically, the country's resources cannot be too well known. Adequate analysis of the land and the factors affecting it is essential.[4] Confining investigations to Bantu areas only (as the Tomlinson Commission did) is simply deficient analysis, and separate development of the area without assessing its links with its surroundings, is hazardous indeed. Thus far, the major impediment to the process of racial segregation in South Africa has been the close economic integration among all the inhabitants of the Republic. The economic interdependence of South Africans does not stop at the borders of a Bantustan or Native Reserve. Practical planning may have to allow for the aims and objectives of the South African government, but the investigations which precede actual planning should still be on a broad national basis.

A further difficulty in implementing a national plan lies in the South African administrative structure. All Bantu affairs are handled separately, including those matters which would normally fall within the jurisdiction of departments of agriculture and planning. Even within the ambit of Bantu Affairs, development may be handled by a variety of agencies, since the Tomlinson Commission's

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[4] L. P. Green and T. J. D. Fair, Development in Africa, Preface.

recommendation for a Development Council was not acted upon. The prospects for a practical national plan would be brighter if the Ministry of Planning was responsible for all matters concerned with planned development. At present, lack of inter-departmental co-operation and the lack of unified direction are obstacles to the achievement of improved land use throughout the country.

II. South West Africa

Since South West Africa is a special case in the sub-continent, its position should be discussed. The territory has been administered as a part of the Republic of South Africa since it was made a mandate of the then Union by the League of Nations at the end of the First World War. The United Nations now considers South West Africa to be its responsibility, and would undoubtedly feel itself called upon to evaluate any development plan for the territory. Any plan oriented to separate development would be highly unlikely to receive the approval of the General Assembly. In an attempt to stem United Nations' criticism of her administration of the territory, the Republic has in the past two years produced new development plans for South West Africa. These plans were aimed at improving the "homelands" of South West Africa's indigenous peoples at considerable expense by consolidating land, acquiring European-owned land and developing facilities such as roads, housing, schools, and hospitals. Needless to say, the plans were not well received by members

of the United Nations, who demanded that the policy of separate development be reversed, and the whole idea of "homelands" abandoned. At present, the Republic retains full control of South West Africa, and it seems unlikely that a United Nations presence in the territory will be established in the near future. While the Republic has in the past ignored General Assembly recommendations about its policies in South Africa or South West Africa, it might be willing to yield a little in the rigid implementation of apartheid measures in the disputed territory. But beyond that the United Nations is not likely to influence development or planning any more effectively in South West Africa than it has in the Republic itself.

III. Rhodesia

The territory of Rhodesia boasts one of the finest surveys made in Southern Africa. Its land resources have been scientifically evaluated and current use has been compared with optimum use. While suggestions have been made for improving the land use of each agro-economic region, no national plan has been produced. The groundwork has been laid and it would be relatively simple to produce a plan incorporating recommended use. As in the Republic's case, the prevailing political climate in Rhodesia is probably a bar to such a plan. Since the unilateral declaration of independence in 1965, the country has been on something of an emergency footing, so that long-term plans have not been

formulated. The racial situation is also very complex: during the period of the Central African Federation, some progress toward integration was made. Under the present administration of the Rhodesian Front, it is unlikely that there has been any drive toward further integration. But the situation is still very different to that in the Republic--a limited franchise for the Bantu peoples does exist, and they have fewer restrictions on their movements and greater rights of land acquisition. Nevertheless, less than half the country is available for Bantu occupation, and all Bantu land acquisition is confined to certain designated areas.

Most of the active land rehabilitation done in Rhodesia has been in the African or Bantu areas. The Native Land Husbandry Act set up a process of land evaluation, planning and effectuation for individual African areas, and this has proceeded well. Since the community participates in the process, this form of planning has not been imposed by the authorities. It is still not planning for optimum use, but a limited type of improvement within mandatory boundaries. It has undoubtedly improved rural land use methods and raised productivity in the African areas of Rhodesia, but it is no substitute for an integrated plan in which all parts of the national domain aim at optimum use.

The Rhodesian example is an excellent illustration of two points made previously: (1) that the existence of Native reserves, Bantustans, or other areas designated for occupation

by specific groups is not in itself a barrier to general assessment of such things as land quality and type of current use; and (2) that the existence of such segregated areas is a barrier to the evolution and implementation of a national development plan. If such areas have to be considered separately, with particular objectives in mind, the national plan gives way to a series of special or regional plans, lacking the unifying aim of optimum use to benefit all the country's inhabitants.

IV. Zambia

Zambia has had a relatively small non-African population and a somewhat ~~difficult~~ different political evolution. Its racial problems are consequently minor compared to those of Rhodesia or South Africa. There is, of course, no policy of segregation in independent Zambia, and none of the country's inhabitants is confined to particular areas. Most of the accomplished and projected planning in Zambia has not been concerned with rural land use, but with urban, industrial and educational matters. There has been no land assessment comparable to Rhodesia's, and certainly no national plan aimed at optimum use. There is undoubtedly a need for such planning and when it comes, the drawbacks experienced by planners in Rhodesia and South Africa should be absent.

V. Botswana, Lesotho, Swaziland

Of these three territories, Swaziland has been the

most active as far as land classification and actual planning is concerned. Rural development schemes based on thorough assessment have generally been very successful in this newly independent nation. The continuing process of evaluation and planning conducted by the Swaziland administration bodes well for the territory's future. Despite the fact that Europeans have rights of land ownership in Swaziland, racial friction has been absent. Multiracialism has not impeded planning here.

Lesotho has had no national land classification, although some preliminary planning has been done in a few selected localities. Because of the grave difficulties faced by the Basuto in using their land--rugged terrain, poor soil, a short growing season, and heavy soil erosion--it is vital to the existence of the nation that every part of the land be used to its greatest advantage. Therefore, assessment and practical planning are imperative for Lesotho.

Botswana, which has different limitations to agricultural development,--chiefly aridity--has as much need for planning as Lesotho. In a national assessment, it may become clear whether the Okavango swamps could feasibly be developed into a highly productive area. Such a project cannot be considered in isolation because of the great cost and its great impact upon the whole country. It is the countries such as Lesotho and Botswana which have most to gain from international co-operation and the pooling of personnel and resources. In

turn they would have much to offer to the more highly developed countries in terms of schemes of mutual advantage, like the Oxbow river development scheme in Lesotho.

Planning Prospects for Southern Africa

Planning must be a national legislative and political decision, thus prevailing political climates greatly affect its prospects. In the Republic of South Africa there has recently been a strong move towards official planning, with the Minister of Planning seeking wide powers. However, this emphasis on planning has not as its aim the achievement of improved utilization of resources. Rather, its aim is the implementation of government policy, particularly in such matters as decentralization of industry. Official policy is the great bar to general planning in the republic, but it is also a spur to the development of certain areas, viz, the Bantustans. Only a national plan which is in effect two plans is likely to meet with the approval of the present regime. There would have to be separate plans for Bantu and European areas, just as there is separation at all levels of South African life. Unless the United Nations were to administer South West Africa itself, which seems unlikely, that territory's planning position would be the same as the Republic's.

Rhodesia's prospects for national planning are somewhat brighter, if the present uncertainty surrounding the territory's future could be resolved. The framework for a plan exists,

except that agro-economic survey for the African areas remains to be done. If a regime favouring integration were to govern Rhodesia, a single national plan might well be implemented. If, however, the present status quo continues, planning would probably have to be in two sections as in South Africa. Such a piecemeal approach would be regrettable.

Zambia and the former High Commission Territories share a similar political climate, one favourable to planning. Once the value of planning has found favour with the administration, as it has in Swaziland, these territories would only stand to gain from survey and the implementation of well-considered plans.

Recommendations for the Development of Planning

The practical problems of classifying land and planning in Southern Africa must now be considered. In the light of work already done in Southern Africa and land classification elsewhere, these suggestions are offered.

When a land classification programme is set up its objectives must be defined. In this case those objectives should be:

(1) the collection and organization of pertinent data about inherent physical characteristics;

(2) the determination of land potential, preferably by agro-ecological survey;

(3) the undertaking of a land use survey to reveal the existing use pattern;

(4) the determination of recommended use, in which the most suitable use for a tract is found by evaluating inherent physical characteristics, land use capabilities, present use and other pertinent factors. At this point, classification merges with planning. Each of the classification stages will be briefly discussed.

1. <u>Collection and Organization of Pertinent Background Data</u>

Existing information on a number of topics should be reviewed in order to determine what information should be added. Gaps in essential knowledge would be filled by research in order to give a balanced picture, e.g., studies of the impact of human activity upon natural vegetation would be of inestimable value to the planner. Useful data would include material on geology, physiography, soils, water resources, climatic elements, (particularly temperature and precipitation), vegetation, the incidence of pests and diseases, and the distribution, composition, trends and movements of the population. More important than the mere assemblage of facts, however, is their organization into meaningful patterns, as these relate to rural land use. Once the compilation of facts is complete, possible problem areas might be isolated. One approach might then be a study of the individual or combined factors which impose limitations on land use, e.g., frost occurrence, broken topography, limited rainfall and low soil fertility. A great deal of the necessary background material has already been collected and organized

by such geographers as J. H. Wellington. In a fractional code system this part of the land classification process would make up the denominator. However, the shortage of skilled personnel able to use the fractional code notation seems to preclude its use in a large Southern African classification programme. It also requires large-scale photographic and map coverage, which is probably unattainable for the total region.

2. The Land Potential Survey

This is the logical second stage, developing from the study of natural characteristics. Its aim is to determine the potential use which is best for a specific area, regardless of prevailing or traditional economic conditions. "A knowledge of the climatic, soil and topographical conditions, coupled with a vegetation survey will give the key to the potentialities of the area."[5] Whether one fully agrees with Pentz or not, an agro-ecological survey is a valuable indicator of the potential use of the land. A true ecological study is one in which the natural environment is studied as a whole, including the inter-relationships between soil and vegetation, and vegetation and fauna. Certain vegetation species may be used as indicators of types of environment, since they reflect dominant natural characteristics. Pentz developed this

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[5]J. A. Pentz, An Agro-Ecological Survey of Natal; Department of Agriculture and Forestry, Bulletin No. 250, Government Printer, Pretoria, 1949, p. 3.

approach in Natal, it was expanded in the Tugela survey, and used in the Rhodesian agro-ecological survey. Its usefulness has been demonstrated in those areas of Natal where Pentz's techniques have been applied to the planning of individual farms, as in the Tugela basin.

The use of ecological indicators would be entirely valid where climax vegetation exists, revealing a state of stability in the interrelationship of climate, soil and vegetation. As far as is known, true climax vegetation is rare in Southern Africa, although small undisturbed patches have been found in such places as the "koppies" (hills) of the Southern Transvaal. The migratory movements of man and beast and plants have contributed to a continuing evolution of vegetation. The natural pattern has also been disturbed by man and his activities, such as fire, pastoral pursuits, cultivation and the felling of trees for fuel. Thus the use of certain species as indicators of environmental conditions is probably not absolutely valid. But the use of a number of common and typical species as indicators[6] should ensure that present conditions are still reflected fairly well, unless there has been a sudden profound change in the vegetation. The value of ecological factors in the survey has been demonstrated in Rhodesia and Natal. It would be a great boon to planners all over the sub-continent provided a uniform system were used over the whole area.

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[6]Pentz, op. cit., pp. 5-10.

In Rhodesia, agro-ecological survey resulted in the demarcation of natural regions "where agricultural development is, and will be, conditioned by one or a few dominant natural characteristics."[7] Such natural regions form a basis for the assessment of potential use. A system of natural regions should be set up as part of the first two steps of the rural land classification of Southern Africa. Drawing upon the data amassed through physical assessment and ecological survey (the dividing line between the stages is often blurred), Southern Africa or its constituent territories could be classified into natural regions and areas. As a general rule, the dominant natural characteristic affecting agricultural development in this part of the continent is rainfall. Thus, "the degree of adequacy and efficiency of the rainfall" is an admirable primary criterion.[8] Natural areas could then be based on soil differences, both rainfall and soil having proved their worth as criteria for the agricultural survey of Rhodesia. Suitable potential systems of land use for each natural area would be in accordance with the permanent characteristics of the land. The indication of potential use would provide a fruitful comparison with present use: potential use provides the planner with his objective, while present use reveals the stage of development already reached, and may be considered the planner's starting point.[9] Recommended use might be considered the stage

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[7] An Agricultural Survey of Southern Rhodesia, Parts I and II, p. 3.

[8] Loc. cit.

[9] Ibid., p. 2.

at which economic, social and cultural influences are weighed with potential use, to determine the most advantageous use of the land.

3. The Present Use Survey

This is the aspect of land classification where the geographer's talents are most frequently applied, although economists do change the emphasis, and label it agro-economic survey. Present use survey is essential to the planning process, in its demonstration of the way the land is actually being used. Knowledge of present use must precede any planning action since present use does reflect traditional, economic and social conditions. There is no question of whether there should be present use survey; the question is how it should be done.

The most important question is what classification should be used. It must be restricted to present use, since other phases of the planning programme deal with inherent characteristics and potential. Most present use classifications are developed for one region and are designed to deal with particular problems. Adaptation is possible, however, and of the many classifications which might be adapted to conditions in Southern Africa, two are particularly suitable. One is Fox's Rural Land Classification of New Zealand, since it was designed for a recently settled country where pastoral activities are dominant. Its chief merits are its logic, the clear relationships between the categories of land use, and its completeness.

Its drawbacks are its complexity and the need for botanically-trained workers to use it well. In its full complexity, it is not an easy classification to apply in the field. However, a simplification developed for South African conditions has been used with some success,[10] although it must be admitted that the test area was small, (approximately 32 square miles), and of a distinct type--a peri-urban area close to Johannesburg displaying the land uses typical of such urban fringe areas, e.g., market gardening. The simplified classification is as follows:

Category	Colour
Land under vegetables	Dark brown
Land under field crops	Light brown
Orchards	Purple
Pasture grassland	Orange
Exotic trees	Dark green
Indigenous bush	Olive green
Water and marsh	Blue
Excavated land	Black
Totally unused land	Yellow
Land occupied by buildings and communications	Red
Recreational land	Yellow ochre

Since the World Land Use classification was designed to be adaptable to a wide range of conditions, it too merits

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[10]M. Breckenridge, Land Use in the Jackson's Drift-Van Wyk's Rust Area, unpublished thesis, University of the Witwatersrand, 1960.

consideration. Board applied it with success in the Border region, finding it required only slight modification to suit African conditions. Used without related studies, this classification is of limited use to the planner, since it simply shows actual use of the land. It is less concerned with ecology than is Fox's scheme, and is therefore easier for less skilled workers to apply. Used in conjunction with studies of physical characteristics and ecological survey, the World Land Use classification could be a key element in the determination of recommended use. It is not constructed as logically as Fox's classification, and its categories do include types of farming and vegetation types as well as present use. Vegetation types can only be eliminated with difficulty from a classification of this kind. Some vegetational or landscape types are more correctly non-use than use, e.g., marshes and sand dunes, but if these were omitted, the resulting map would be incomplete. With respect to the categories which are more correctly types of farming than actual use, minor changes in terminology would probably make all the difference between an illogical and a logical classification. Thus, horticulture (a farming system) might be changed to "intensive vegetable growing" or "land under vegetables" in order to maintain as logical a classification as possible. With respect to other changes, Board's modifications, made especially for the Border region, would probably not be altogether suitable for the whole sub-continent: for example, such a category as "perennial crops, including orchards and bananas" would need to become less specific.

The chief advantages of the World Land Use Survey classification are its ease of use and its already widespread application. Since the classification is suitable for use in the Southern African context and satisfactory in most respects, it would surely be advantageous to conform with similar projects elsewhere. Frequent application of a classification to a variety of areas and conditions inevitably facilitates its use. And the ideal of world-wide land use mapping may come a little closer to attainment if the Southern African piece can be inserted into the global jigsaw. It has been demonstrated that the classification is simple to use, both on the ground[11] and in air photo analysis.[12] Board maintains that his use of this classification allowed for possible reduction to the one to one million scale. He considered the classification also quite suitable for use in sampling procedures.

A suggested classification for the present use phase of the rural land classification programme for Southern Africa, based on the World Land Use Survey scheme (with some adaptation after Fox) would be:

No.	Classification	Colour
1a	Built-up areas	Red
1b	Non-agricultural land associated with built-up areas	Orange

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[11] It was the basis of the second British Land Use Survey classification, 1961.

[12] The Sudan Land Use Survey, 1959, based on the World Land Use Classification, was done chiefly by air photo analysis.

2	Intensive fruit and vegetable growing	Purple
3a	Cropland	Dark brown
3b	Fallow cropland	"F" symbol on dark brown
4	Improved permanent pasture	Light brown
5a	Veld (Unimproved pasture) used for domestic animals' grazing	Buff
5b	Veld not used for grazing of domestic animals (includes game reserves)	Yellow
6a	Exotic trees	Dark green
6b	Indigenous trees	Olive green
7	Marsh	Blue
8	Unproductive land--sand dunes, bare rock, land sterilized by mining or industry	Grey) "U" for unproductive) "W" for waste land
	All irrigated land	Vertical hatching over base colour

This classification is very similar to the one developed by Board for use in the Eastern Cape Province, but several categories have been broadened for greater applicability. The classification works well at a scale of 1:125,000, which was the chosen scale for the Border survey. It is also suitable for larger scales, up to and including 1:18,000, since it is quite detailed. Map coverage of Southern Africa is patchy, as is aerial photographic coverage. At present only one mapping scale, 1:1,000,000, covers the entire sub-continent. If adequate large-scale photographic coverage could not be arranged for the present land use mapping of Southern Africa,

the proposed classification might have to be simplified, as Board suggests, for mapping at 1:1,000,000.[13] Categories would then have to be combined because of the difficulties of recognizing certain features at such a small scale. Improved permanent pasture could not be distinguished from cropland, nor could exotic and indigenous trees be differentiated. Board's simplified classification, for 1:1,000,000 mapping, is:[14]

No.	Classification	Colour
1	Built-up areas and associated non-agricultural land	Red
2-3	Horticulture and perennial crops (Intensive cropping)	Purple
4-5	Arable and fallow	Brown
6	Veld	Buff
7	Woodland	Green
8	Marshland not used for grazing	Blue
9	Unproductive land	Grey

Even with a simplified classification, it is likely that the mapping of dominant use would have to give way to the mapping of mixed uses, shown by a system of coloured stripes of proportionate widths. It is to be hoped that these expedients will be unnecessary, as a land use map at 1:1,000,000 will be of little use for planning. A scale somewhere between 1:50,000 and 1:250,000 would be much better for this purpose.

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[13] C. Board, The World Land Use System and South Africa, South African Geographical Journal, Vol. XLIII, 1961, p. 23.

[14] Loc. cit.

At present roughly half of the Republic of South Africa has been mapped at 1:50,000, and about two-thirds at 1:250,000. Given government co-operation, it should thus not be impossible to fly photographic coverage for the unmapped parts, while using the photographs already taken for the remainder of the country.

Because of the lack of map coverage and the vast areas involved, a sample survey would be necessary. This system has worked admirably in Swaziland. Unlike Swaziland, Southern Africa generally does not show the marked influence of physiographic or other zones on land use, so random sampling might be unnecessary. Instead, Board has suggested a systematic area sample,[15] utilizing a system of regularly spaced points which would make up a sampling frame. The overall picture of land use obtained by systematic sampling should provide an excellent basis for the recognition of those areas requiring further, more detailed study.

A most important aspect of the present use survey is statistical. The chosen categories of land use should be measured, in order to discover their proportions. If aerial photographs are used, a template of contact print size[16] could be used. The usual South African contact prints at 1:36,000 could be used with specially constructed dot sampling templates, to measure the relative proportions of veld and

[15] Board, op. cit., p. 25.

[16] Ibid., p. 26.

cropland, for example. Other data would have to be collected, especially those for number of livestock and crop yields. Some field checking for this could probably not be avoided, although agricultural officers doubtless would have pertinent records. In the Swaziland Sample Survey, dip-tank counts provided the necessary information about livestock, and such a procedure might be applied elsewhere for Bantu areas, but in many areas of Southern Africa, public cattle-dipping facilities are not usual.

4. Recommended Use

The Rhodesian agro-ecological survey outlined farming systems tailored to the conditions of each natural area. Unlike the studies of Western Canada which used suitability for wheat production as a yardstick in land classification, no one use was a criterion in the Rhodesian study. Monoculture of maize (corn) in Southern Africa could hardly be encouraged, considering the great danger of crop failure with this staple crop.[17] Rhodesian agricultural experts drew on their knowledge of the natural area's attributes in order to suggest the optimum use for that area. This potential use was later compared with actual use in the agro-economic survey, thereby pinpointing anomalies and conformities. In many cases, an economic incentive was found to be responsible for a departure from the use most in harmony with natural conditions.

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[17] Maize requires certain minimum amounts of precipitation at particular periods of growth. Drought of even a few days at the critical stage may cause total crop failure.

Recommended use should take the economic element into account, if practical planning is to result. Idealistic appraisals of what should be grown will carry little weight when a land-user has a strong economic incentive to produce something else. Arrival at recommended use is a three-part process:

(a) optimum potential use should be decided in terms of the ecological survey, the sum of environmental characteristics, and crop and livestock requirements. Detailed farming systems should be drawn up for regions throughout Southern Africa, following the Rhodesian example.

(b) present land use should also be analyzed to determine where it approaches optimum potential use, and why it departs from the optimum.

(c) finally, in the light of the area's natural attributes and actual use, the planner should be able to make recommendations about the most suitable use for the present and foreseeable future.

In order to make really valid recommendations, national development policy should be set up and followed. However, once priorities have been established and national aims set out, planning is likely to proceed best within a regional framework. Even the planning of racially separate areas should be organized regionally. The region having more or less uniform development potential, like the region with a common problem or set of problems, makes a better planning

unit than does an arbitrary territorial unit. Green and Fair have drawn up general development regions for Southern Africa using criteria based on distribution of resources and facilities.[18] These development regions are a valuable guide to the planner, but more detailed use recommendations are necessary for practical rather than academic or theoretical planning.

The ravages of poor land use are evident throughout Southern Africa, particularly in times of drought, when malnutrition is rife, and the cattle die and the crops fail. The remedy lies not in emergency help to tide the land-user over the crisis, but in long-term planning aimed at achieving forms of land use well-adjusted to prevailing conditions. After thorough investigation, detailed plans capable of implementation should be drawn up. Such plans will of course have to conform to the realities of the political situation, as all practical planning must. But the planner should not allow his goal of achieving optimum use to be completely lost to political ends. Any plan which is put into effect should be subject to constant reassessment and review, as no area is ever static. The process of geographic change continues, societies change and evolve, and technology advances. A continuing programme of assessment and planning would be a great aid to the full development of Southern Africa.

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[18] Development in Africa, Witwatersrand University Press, 1962, Ch. 9, pp. 103-124.

ADDENDUM

The practical problems of gathering necessary data have seriously impeded the process of resource inventory in Southern Africa. Conventional data-gathering techniques are often slow and expensive, while data gatherers may be denied access by considerations of time, distance or by political barriers.[1] Aerial photography has done a great deal to facilitate mapping of all kinds, but aerial coverage of a large area is still expensive and far from synoptic. Because of the general reliance on conventional photographic materials, photographic missions are usually restricted to good weather during daylight hours.

Recent advances in the development of orbiting spacecraft and sensory devices which can be used to record terrestrial phenomena have opened a broad vista of possibilities to the geographer. A variety of cameras, infra-red scanners, imaging radars and other remote sensors will be able to record many things which are not visible to the human eye or the conventional camera. Spacecraft orbiting regularly can allow changes to be traced, by providing synoptic coverage periodically, once basic inventories have been taken. The value of such a programme is largely dependent on data being made generally available to all interested individuals and bodies from a central agency. International co-operation and parti-

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1 The material for this section comes from Spacecraft in Geographic Research, Publication 1353, National Academy of Sciences, National Research Council, Washington, D.C., 1966, p. 56

cipation would be essential to the success of a programme using spacecraft for geographic research, thus existing security restrictions would have to be eased. In order to make spacecraft observations usable "ground-truth" or actual ground conditions would need to be correlated with these observations. Just as in the analysis of aerial photographs, field checking is always highly desirable, so the results of space observations should be tested and evaluated at selected sites. This would assist both in improving a programme using spacecraft to study the earth, and in training personnel in the techniques and applications of this new field. Furthermore, once ground-truth has been determined, valid generalizations can be made from known to unknown areas.

Existing sensory equipment already allows the direct perception of broad patterns from satellite observations. Refined resolution will permit the identification of very small features, thus greatly extending the range of possibilities offered by the use of spacecraft. A world land use map at 1:2,500,000 has been postulated, using this method: in time world coverage of land use may be possible at scales as large as 1:250,000. In order to obtain world-wide coverage, spacecraft would need to be in polar orbits, not the more usual tropical orbits which provide only partial coverage of the earth. Because of the high cost of such a programme, priorities would have to be established. Since there are huge gaps in present knowledge about the world's soils and

vegetation, land use and land-forms, basic inventories of such things would be extremely useful. Once the present situation is known, significant future changes could be observed, and the processes at work could be studied.

There is an immense potential for the use of satellites in the provision of background data required for land classification in Southern Africa. Essential base maps could be drawn from satellite observations. Not only could such broad patterns as general soil and vegetation distribution be mapped, refined sensory equipment would greatly assist in the studies of particular areas at large scales. If the opportunity existed, the present use of the entire sub-continent could be recorded without resorting to sampling. Another promising aspect would be the opportunity for periodic synoptic surveys, in order to gauge the progress made in planning and general remedial measures.

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